IFGA EXTRACTS

Book Five

FORWARD

The Extract Series Volumes One, Two, Three, Four, and Five is dedicated to the International I would imagine that you are surprised that there is 5 Volumes. Frankly I am too! Originally I wanted to buy Extract one, but they were not available. One day I got a call from a member that had a photo ready copy of Extracts One. I took this to the printer and had copies made. After reading it I realized the articles were very good.

At one of the G.A.M. Meetings I discussed with Dick Wagner about using His back issues of the I.F.G.A. Bulletin to make Extract Two. Well Dick pulled out two large boxes of back issues. I thought I would read the articles for my own personal enjoyment and pick out only the real outstanding articles for reprint. After spending a couple month's reading the articles I found 900 pages of good articles. I divided the articles into sections according to subjects. So each Extract has different subject material and goes into great detail.

My real motivation to complete the Extracts, was the fact that all the people that bought Extracts One wanted to know if there would be Extracts Two and I said "Yes in the fall of 1988, so sure enough in the fall of 1988 I started to get checks for Extracts Two. So I guess a promise is a promise. The Extracts Series is available at $15.00 per copy post paid, Canada $16.00, but please indicate which volume you wish to order. Make all checks payable to The Guppy Associates of Milwaukee, Bill Klein, 739 S. 122 Street, West Allis, Wisconsin, 52214, 414-771-5935.

Enjoy the articles, and whenever you have a problem with your guppies go back to the Extract and read them again. You will be surprised how each time you read them you will be looking for solutions to new problems.

THE SEXUAL BEHAVIOR OF THE GUPPY

by Dick Ainsworth

Some of the earliest works on the sexual behavior of the guppy appeared in 1910. Since then, many researchers have re-examined these works and have developed new ideas and theories. Before 1928, it was assumed that the male guppy did not have to make contact with the female for insemination to take place. The most common theory of that time was expressed by Schmidt in 1920 who felt that the male had to just get close to the female's genital region. The male then shot spermatophores toward the female as if he was using a pea shooter. These glutenous balls would attach then to the genital region of the female's papilla. The explanation as to why these balls did not dissipate in the water was expressed in 1929 by Vaupel. It was felt that the sperm ball or spermatophore is formed with a compact ring of sperm, their heads around the circumference and their tails towards the center of the sphere. As the spermatophore travels through the canals, the heads of the sperm withdraw from the ball and their tails are entwined. This explanation seems to be still valid today.

The first theory which suggested that the male had to make contact with the female was by Stepanek in 1928. Stepanek reported that after four years of work, he was convinced that the male not only made contact with the female, but the gonopodium is inserted into the female's duct for several seconds before insemination occurs. He went so far as to say that on the male's gonopodium (third ray) there is a hook, and the female cooperates in the actual insemination by closing over and holding onto the hook with her genital opening. It was shown by Sengun in 1949 that the terminal hook is not necessary for insemination, but the idea that the female was receptive in the insemination stage was first reported by Stepanek. It was believed at the time that there was no cooperation of the female in the mating act. Some researchers and hobbyists even felt that the male had to "sneak up" on the female to complete the act of insemination.

In 1939 another report appeared that gave some indication that the female was receptive to the male's advances. This report was by Jaski, who felt that there was a 4-6 day cycle when the female was influenced by a hormone secreted into the water by the male. It was believed that this hormone influenced the female's swimming angle. When the angle changed by about 20°, the female was receptive to the male's advances. This report is questionable, and as yet research has not confirmed these findings.

In 1951, Clark and Aronson ran a series of experiments that showed there must be contact between male and female guppies for insemination to occur.

During 22 observation periods, the female received from 2 to 234 non-contact thrusts without any short or long copulations taking place. None of these females were inseminated. Nine of these were sacrificed 17-20 days later and none contained embryos. In this report the non-contact thrust is a thrust where the male's gonopodium comes close to the female's genital area but does not touch her. The contact thrust is when the male touches the female lightly with the gonopodium. Short copulations are much like the contact thrust, except longer in duration, the short copulations being reported as lasting at least 0.8 seconds and the long copulations as averaging 1.3 to 2.4 seconds.

It was also shown by Clark and Aronson (1951) that the female does not have to be with the male 3-5 days as stated by Jaski. This experiment showed that virgin females which have never been in water containing males (until the day of the test) were receptive to the males the first day. Some females were even receptive within minutes from the time they were introduced into the male's container. It would seem therefore that the male does not secrete any type of hormone into the water to excite the female. This has also been confirmed by Rosenthal (1952).

Another interesting test by Clark and Aronson was the mating activity in community tanks. It was found that out of 54 females only 26 appeared to have been inseminated within a one week span. The

experimenters did not report on the number of males used but it was reported that they used "many males in each tank".

All females were tested with a sperm detection smear technique developed by Eugene Clark, Lester Aronson and Myrin Gordon. It was also shown that in all cases where the female showed a positive test for sperm there had been at least one short or one long copulation.

Another theory was that the male had to "sneak up" on the female for copulation. We find though that in their natural habitat the guppy is a schooling fish, and within this school there are rare attempts at mating. In fact, the male attempts to lure the female from the school before mating attempts occur. If he succeeds in luring her from the school, he will attempt to change her movements and then go through his mating performance.

The male's courtship performance can be found in any good book on guppies and accordingly only the basics will be reviewed here.

1. The male swings the gonopodium from the back pointing position to the front pointing position. Whichever side the gonopodium moves towards, the pelvic fin on that side moves to meet it. The rays of the pelvic fin closes over the gonopodium forming a type of tube for the sperm to travel from the male to the female.
2. Thrusting of the gonopodium.
3. The male's body seems to form into an s-curve. At this point the caudal of the male spreads to its fullest width.
4. The quivering of the body.
5. The mating attempts.

Now that we have covered some of the mechanics of the mating act of the guppy, let us go into some of the finer factors that cause the mating attempts.

Several factors that seem to regulate the male's mating attempts are:

1. The large females induce more vigorous mating attempts in the male than do small females.
2. Pursuit of the female tends to be more vigorous shortly after females have delivered young.
3. The longer the period that the male has been separated from a female, the more vigorous the mating attempts.
4. Males tend to be less vigorous towards individual females with whom they cannot mate.
5. The male's normal development of sexual responsiveness is dependent upon learning behavior. In other-words, the male must learn through behavioral interaction to be responsive to the female's positive sexual responses. (Liley, 1966)

The female is seemingly much more complex when it comes to sexual behavior in that she does not give us an obvious sign that she is ready to mate, as does the male. In fact, it appears that she is always trying to escape the male's advances. But as we have seen, the female must be receptive for reproduction to occur.

What induces the female guppy to receptivity? In non-virgin females this problem is tied up with the condition of her pregnancy. Receptivity is not influenced, as some observers have said by the presence of free sperm in the water or by some substance of a suspected chemical or substances derived from sperm or other products secreted by the male. Apparently females, virgin or not, are influenced in their mating behavior by their own internal hormonal secretions, past experiences, and the visual and motile excitations produced by the presence of a suitable male. (Gordon, 1955)

In the female, it has been shown that the non-virgin female is more receptive and accepts the male advances during the 3-4 days following giving birth to fry. The first female is actually more receptive than the non-virgin, but this receptiveness lessens at the start of embryonic development. The receptiveness of both virgin and non-virgin females often seems to be related to the maturation and rapid growth of eggs prior to fertilization.

Liley (1960) has shown that the female's sexual responses are regulated in the hormonal secretion of the pituitary. In a series of experiments using males with their gonopodium removed, it was shown that the removal of the pituitary evidenced a rapid decline in the sexual behavior of the female. Females that had their gonads removed initially showed a decline in sexual response but after 10 weeks were on about the same level as non-virgin females. Liley showed that the gonads, not being essential for sexual response, were important in the regulation of the sexual behavior by control of the well defined egg production cycle in the non-virgin female. It is to be noted that the virgin female generates mature eggs over a longer time period and does not show the same well defined cyclical production of eggs as does the non-virgin female. The one common feature of the virgin and receptive non-virgin is the presence of a rapidly growing ova. This has been linked to the pituitary and supports indirectly by evidence of a pituitary involvement in the cycle of brood production from experiments by Stolk in 1951 and 1961, and by Ball in 1960. It appears that the period of greatest receptivity of the virgin and non-virgin female coincide with vitellogenes which is believed to be induced by pituitary gonadotropic. Vitellogenesis is the process of commencement of yolk formation in eggs.

To follow this work through, Liley and Donaldson (1969) using basically the same strain of fish and the same surgical procedures as Liley (1968) found some interesting results with hormone treatment. The hormone used was pituitary gonadotropic from the pacific salmon (Oncorhynchus tshawytscha). The tests were with hypophysectomized females (pituitary removed) and their gonads intact, and another group which were gonadectomized before hypophysectomy.

The tests indicated that there was egg development in hypophysectomized females that were treated with the hormone, while the females not treated evidenced egg regression. The sexual responses were not as clear cut, but there was some receptiveness in females that were hormone treated. The overall results seem to indicate that the pituitary gonadotrophin alone does not regulate the female's sexual behavior, but works with the ovarian hormone.

As stated by the researchers: Perhaps the supposed ovarian no hormone is directly involved in regulating the excitability of the sensor motor mechanism underlying the sexual response. Whereas the gonadotropic is involved in retaining a certain physiological state until the ovarian hormone exerts its affect. Either of these hormonal effects may be influence the threshold at which the female responds to stimuli provided by male courtship.

Reprinted from The Guppy Forum

METHODS OF RESTRICTED GUPPY BREEDING

by George B. McCroskey

This article is written for those persons who would like to breed good guppies but are handicapped in either the money line or have restricted space. I don't mean to say that it is likely that the methods given will attempt to compete with the breeders who keep great numbers of tanks and can choose breeding stock from hundreds of fish and several different strains. It is a method that has been modified to give a few guppies of reasonable quality and possibly a very few of an excellent quality. It differs from the better known ways of breeding fancy guppies only in the smaller size of the tanks used plus the means to take advantage of fewer tanks. Persons living in small apartments, mobile homes, and with limited funds can use these suggestions to breed fancy guppies.

RULE NUMBER ONE -- NUMBER OF TANKS.

For any one kind -- or strain -- of guppies to be bred, at least three separate and individual tanks will be needed to just maintain this strain of guppies.

If you desire to attempt the improving of these fish, as most of us do, you will have to add two more tanks to this number. Size is relatively unimportant to start. While 30-gallon tanks may be desirable, five-gallon tanks will do, provided you can be satisfied with smaller numbers of guppies. In extreme cases, even two-gallon tanks can be used to breed fancy guppies provided the extra time is available to clean them more often, to sort (cull) out the young fish and to otherwise make for more nearly perfect conditions.

Filtering of the tanks is almost a necessity. The type of filter to be used is not important as long as some type is used. Without going into all methods of filtering aquariums, I would advise the consideration of bare bottom tanks to allow for easier cleaning, and to give the maximum in water space.

Another thing which is desirable but NOT absolutely necessary is enough light over your tanks to grow some type of plant. Some of the best guppies are raised without this feature but a few floating plants growing well does wonders in looks, provides havens for young and timid female fish and still gives the fish natural conditions. Hornwort, nitella, watersprite, anacharis, and bladderwort all work well with guppies.

RULE NUMBER TWO -- BREEDING STOCK.

I well realize that good breeding stock is not easy--or cheap to come by in certain parts of the United States. If this is one of your problems, look through the advertising section of any commercial aquarium publication and consider ordering your fish by mail-order.

Do not attempt to order more than one color or kind at first. If red guppies are your favorite, stick with this one fish. You will have far too few tanks to do much good with several kinds no matter how big the temptation.

If you are one of the lucky ones and can go someplace and choose your fish, by all means pick young fish. Never more than four months old and preferably get females already bred. An old wide tailed male guppy is fine to look at, not so good to breed with, especially after he has been moved several times from his original breeder. I much prefer some kind of baby guppies than no fish at all, which is likely to happen if virgin female guppies are put in with old males. Another thing, two females are just about twice as good as one, so if you can afford a trio of guppies to start with, do so. Especially so if you must order your fish mail-order.

The older strains of guppies are apt to be truer breeding and unless you have access to some of the special newer strains I would advise sticking to the reds, blues, or greens. At the start of any guppy breeding program the biggest handicap is to get fish true enough in breeding to make a fair start. Even the very best of fancy guppies that are available are apt to only breed 50% true and this becomes a real problem to start with. No matter the color of the fish chosen, you will have to concentrate on this one strain for up to about two years before you can attempt any branching out. There is only ONE exception to this rule and I'll describe it for those having an interest in this method.

Pick a breeder of fancy guppies, agree to buy his very best and truest breeding stock and pay the price. It will be high, probably in the neighborhood of 125.00 per pair. Use these fish as breeders and with a little care and by breeding the best of each litter to each other you can get good guppies for approximately two years. Then it will be necessary to go back and buy new stock for breeding. This new stock can either be crossed back into your own, or used exactly as the first pair. Either way will give good fish again but be considerably less trouble than keeping and improving the strain by standardized methods. From a monetary standpoint it can be quite profitable, IF you can sell your surplus fish, or can win often enough at area shows to make it worthwhile. Many, many people employ this method of raising fancy guppies and it can be done with few tanks and the minimum of effort. The only drawbacks are its cost in stock purchased and the availability of breeders who will sell you good breeding pairs.

For persons with limited space and facilities, it is possible to breed good guppies and keep them good provided they compromise on quantity and make up for this by "exceptional care". This, combined with good breeding practices can give you guppies to compete with the best--in one kind only.

RULE NUMBER THREE -- BREEDING METHODS.

Some of the suggested rules given under this heading may sound very radical and harsh. They have to be or the restricted space you have will be less than useless. If you find that you cannot follow these suggestions, you can never successfully raise fancy guppies. It is as simple as that.

Taking for granted that you have set aside five tanks for guppy propagation, follow these steps:

(1) In one tank put your breeding pair or trio. Carefully record the date, the age of the fish if known and the source they were obtained from. Some do this by means of cards fastened to the tank front. Others keep a file record. A few do both. I usually compromise and write with a felt tipped marker on the tank frame the dates and kinds of guppies contained. Further information of a more detailed nature is on file cards. Remember, all baby guppies look much alike and it is a long wait before you can see enough color in young males to guess what kind of guppies they may be.

(2) After the female guppy drops her young, remove the parent fish. Put the female into one tank, the male into another. You now have three tanks occupied, and two empty and waiting tanks. As soon as you can, begin to sex the young guppies. Put the female fish with the old female or into a new tank. The male fish can go into the tank with the original male parent where they will stay until mature.

Here is where the hard part comes in. If this first litter of guppies was large, that is twenty-five fish or over, you now MUST discard all but three female fish and two male fish. Either give them away or flush them down the sewer. The biggest question is which are to be kept. This, at its very best is a compromise situation and will be mostly guesswork in this final attempt. Pick the male guppies for early coloration, brightness of color, and for vigor. Tail width is one thing that cannot be determined usually at this early stage. Later on as you become more familiar with the strain, you can guess very close which fish are the exceptional ones.

Under the limitations, you now should have two young male guppies and three young virgin female guppies. These are probably of doubtful quality due to the first mating being of unknown parentage. The next litter of young is the important one and I would advise extreme care. From your records, you should have a good idea as to when the fry are due and several days before the 28th day, move the heavy female to the remaining clean and empty tank. If the tank is small (under five gallons) it is quite likely the female will try to eat her young as they drop. A heavily planted tank is better than a breeding trap, although either can be used. If large numbers of young are seen, all well and good, but if the female is small, you will need to try and save all the babies you can.

(Editor's Note: The author is assuming the purchased female was bought pregnant, as he suggested, so that the true father of the first litter is unknown. The assumption is also made that the second litter will be fathered by the purchased male. The Latter assumption will only be true if the male is put with the female immediately after the first litter is born).

This (second) is the litter that your future breeding stock will come from and the bigger the selection to choose from, the better. As with the first litter, you can save only a small percentage of the total while the rest have to be discarded. As soon as possible, pick out three virgin fish and add to the tank with the other three females from the first litter. Actually, you can breed your females while small, as you don't care too much for large numbers after the second dropping. About two months of age is OK or when the fish reach about one inch in body length. This is large enough to give 10 to 15 baby fish which are still more than you can use.

What we are striving for is one tank to be used for virgin females only, another for male guppies, a third with newest litter growing up to be sexed and a spare tank for the newest breeding attempt. This gives you one tank for either another breeding or to use for a litter of babies growing up. In practice, this may be quite variable depending on your success with the original pair. Watch out for overcrowding, one of the biggest drawbacks to this system. The only real cure for this is heavy "culling" of the young fish.

RULE NUMBER FOUR -- EXCEPTIONAL CARE AND FEEDING.

The exceedingly complex nature of this subject is one that can only be briefly outlined in this article. In essence, it means giving your guppies the very best of perfect care. This is the only method that can make average guppies into exceptionally good ones. As soon as guppies are born, a program of heavy feeding is needed to give them the early start toward early maturing. The very best method to do this is to feed baby brine shrimp, but this has to be the basic diet for the first three weeks of the fishes life. A once or twice a day feeding of a finely powdered dry food helps but is apt to be ignored unless of high quality. If a "paste type" of food is available (some commercial firms make and sell this, most guppy breeders make their own), in between feedings of this does much to make guppies grow. Even a fish-style of cat food will make excellent food for growing guppies if not overfed.

How much is too much in guppy feeding? Probably no one knows. Many feed as often as twelve times a day, even more under 24 hour lighting. Some commercial and semi-commercial people do this. If you have the time, or there is someone available throughout the day to do so, feed every two hours. A compromise is twice in the morning and three times in the afternoon and evening.

Under this amount of feeding, a stringent program of water siphoning and filter cleaning is necessary. If the time can be had, each and every tank should have 1/3 of the water changed weekly. This is done by using a small hose, siphoning water and debris from the tank bottom and then adding fresh water to fill the tank back up. After settling, this old water is excellent for brine shrimp hatching. In fact, it is better than newer water and gives both better hatches and will sustain baby shrimp for a day longer.

Without going too deeply into reasons, fresh water added to guppy tanks does a grate deal toward making better guppies, other than the easily seen reason for a cleaner tank and cleaner water.

About 5 to 8 guppies to a five-gallon tank is very good. If well filtered and maintained, 10 guppies can be kept; but this is almost too crowded to do the best with them. About two normal sized fish can be kept in a 2-1/2 or 3-1/2 gallon tank, but this can be stretched to 3 or 4. If at all possible, keep 3 smaller tanks and make the other two 7 or 10 gallon ones. In this way, you can keep a larger litter of babies for the first 3 weeks before sexing in the larger tanks and then transfer into the smaller holding tanks. Older developing male guppies seem to do better in smaller tanks as the wide tail develops. Virgin female guppies gain size rather slowly. By breeding females relatively early, some strains give off fewer but better quality fish. It is hard to tell which is better among fancy guppies, the fish from the first or second litters. In most cases, one fish to breed and one kept as a spare is enough. Three virgin female guppies will cover for any eventualities. The extra fish if not used, can be traded for another good male from another breeder which can give your fish a needed boost later on.

RULE NUMBER FIVE -- FURTHER NOTES, HINTS AND HELPS.

By keeping to a rigid planned schedule of maintaining the tanks, feeding well and often, by breeding only the best of your fish together, there is no reason why you cannot have good guppies. As this article can only give the method and not so much the way to do it, you will have to get other standard books to find out the proper way to maintain your fish. Feeding methods and kinds of foods, the way to prepare and keep them, and the equipment necessary to do the best job are all well stated in many standard publications.

Certain things are a must in the breeding of fancy guppies. By choosing the largest, most colorful, and virgins of each generation to breed for the new generations, you will make great progress with your fish for up to 7 generations or longer. After this period of time, usually about two years, you will have to look around for a new male to breed into your fish. As it is best to get related stock, try to obtain this new fish from the same source as the first pair. While it can be done, don't make the common mistake of breeding in another color to the fish you have been working with. Only gold or albinos work well in doing this and they have problems of an entirely different nature.

By keeping male guppies in one single tank, by segregating the young virgin females, and by using the other three tanks for mating and for litters of young fish, you should be able to do very well. With time and experience, you will begin to see ways to further make better use of the available space. As an example: when adding new virgin females to the proper tank, they will be smaller than the ones now in it. Therefore, you should be able to distinguish them from the others on your records. As you must use the fish while they are still relatively small, there is no danger of the small ones catching up in growth with the larger, older fish.

Certain kinds of fancy guppies now available are easily distinguishable from other kinds even when mixed together. The 3/4 black guppies and the 3/4 black-red guppies are some of these strains. Even the females carry the black markings which makes them easy to carry together in the fame tanks with other virgin females without danger of getting the two mixed. Gold and albino guppies are others that can be carried along with the normal gray guppies with a minimum of extra tanks and related equipment being necessary.

There is one danger of using small tanks. Fancy guppies when bred and raised in confined areas tend not to get enough real exercise to be able to carry the large tails well. They become "tail heavy" which means it is likely to detract from their appearance. This means that sometimes it may be best to put a spare female fish into your tank of developing male fish to give them the needed exercise. This is also likely to happen with female guppies who are kept virgin too long. They get sluggish and hard to breed, so either

breed them before this is likely to happen or destroy them.

Color is the first thing apt to show poor in fish that have been inbred too long among themselves. When this appears, start considering new breeds to breed into your stock. If this is not done in time, body deformities are likely to begin to show in your fish.

In adding new water to your tanks for that lost by evaporation or by siphoning, it should be water that has "aged" for at least 24 hours. In small tanks this is especially important, but in tanks of ten gallons and larger tap water can usually be used.

Reprinted from GUPPY CHATTER by way of RAGGED TALES, February, 1974.

Editor's Note: This article is a little bit old but most of it is still quite true. I would suggest that if you're trying to improve or establish a strain that the fish can be crowded a little more so that there is a larger group of stature fish to choose from. Their size will be affected by the crowding but I think this is preferable to flushing a fish that could have saved some time. Once they look right to you the crowding can be reduced to gain size.

HOW TO RAISE PRIZE-WINNING GUPPIES

1. A fancier maintaining but one strain can do wonderfully well with six or eight tanks... Preferably two tens, six fifteens.

2. It is preferable to use medium sized tanks, about 10-20 gal in capacity. Too small a tank inhibits the growth of the guppies, but too large a tank not only limits the capacity of the normal Aquarius to fit as many tanks as are necessary into the space available, but also wastes breeding capacity.

3. A start must be made with a guaranteed stock of good guppies from a reputable source, preferably a male and two females. Do not hesitate to pay a premium price to ensure that you'll get what you really want.

4. For breeding, a temperature between 72 and 76' is best, and the young themselves do best at about 80 for the first few weeks of life, after that time the temperature may be lowered towards 72'. -

5. There is tremendous differences between early live brine shrimp feeding and predominantly dried foods feeding in the guppy. The young guppy responds to live brine shrimp with a much better growth rate and eventual development.

6. The great advantage of using live brine shrimp is that it will last in the aquarium for quite some time. -Thus, it can be generously fed only once or twice a day, and a sufficient number will be around for the young guppies to go on eating throughout the day.

7. The chief reason so many fanciers fail to raise guppies to their best is because they do not feed often enough. The period in which their digestive tract fills and empties is short. Any healthy guppy will eat ten times a day.

8. I feed live brine shrimp twice a day and a variety of dry foods five times a day. (For those- of you who work all day, I strongly recommend Instant Wardleyburger and live brine shrimp.

9. There is absolutely no question of leaving males and females to breed together in a single batch. Everything will go wrong. The quicker, smaller and more runt-like males will do most of the fertilizing. This will result in a rapid deterioration of the stock of guppies even-though the strain had previously been brought to a relatively perfect State.

10. Sexing: Use a strong light. At about three weeks, if a 100 Watt light is held over the babies, a dark spot near the vent can be seen in the female's, which is lacking in the males.

11. Males: Use the best young males. Out of every tankful some stand out far in advance of the rest. A word of caution.... do not wait until the males are fully matured and in their prime to introduce them to the females. Old, fully developed males are not always fertile or able to complete the sexual act efficiently.

SELECTING BREEDING FEMALES

By E.B. Porter

In the last two years, at many of the shows I have attended, the conversation generally turns to the selection of females for breeding purposes. Usually someone will get around to suggesting a short, stubby female to enhance size and strength in the male offspring.

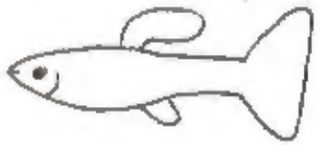
For the last year I have studied certain traits in females and how they affect the offspring male and female; with the following results:

1. STOCKY FEMALES

Using this trait in the females bred to my best males, I found that within three generations I had, very stocky females with large peduncle areas. However, these females were not suitable for showing; unfortunately, neither were the males. Although they were very large bodied, they were not properly proportioned with dorsal size and caudal length.-

2. Using a large female that was well proportioned, in three generations I had developed a very nice female that was show caliber. The male offspring were will shaped and were definitely show quality.

3. Using a large female that displayed a wide caudal angle (not shark-tailed) with a high dorsal (not unusually long) that showed no noticeable point, I finally established a method that works for me. The males came on strong (they won) and the females would show.



In summation, I look for young females at age two months that are large and have higher dorsals than their sisters. I isolate these in ten gallon tanks and feed them a high protein diet with powdered milk as a supplement. At age four months I pick the females that are the largest with the widest caudal and best dorsals and breed trios with my best males. I find breeding young females gives the best fish...male and female.

FACTORS REGULATING FEMALE GUPPY RECEPTIVITY

The following summary is reprinted from: Liley, N.R., and W. Wishlow. The interaction of endocrine and experiential factors in the regulation of sexual behavior in the female guppy Poecilia reticulate. Behavior 48:185-214. 1974

1. A large proportion of virgin female guppies, are highly responsive when first placed with actively courting males. This responsiveness wanes over several days if a female is repeatedly exposed to male courtship in a standard test situation (15 minutes per day on alternate days). The decline in response occurs even though copulation is prevented by presenting males which have been gonopodectomized (gonopodium removed).

Many females became responsive again for a short period(s) some time after the initial period of receptivity at the start of testing. Examination of individual records of females tested for up to 6 weeks suggests that there are cycles in responsiveness which correspond closely to the 20-21 day cycle in receptivity demonstrated in non-virgin fish (Liley, 1966). The data indicate that a virgin female is likely to be initially highly responsive whatever the stage of her endogenous cycle, but after involvement in courtship a cycle in responsiveness becomes apparent.

2. Naive virgin females were highly responsive when first tested 2, 10 or 24 days after ovariectomy (Experiment 2). However, in contrast to intact fish there was no reappearance of receptive behavior after sexual activity observed at the start of testing had waned.

3. The rate of decline in responsiveness of naive virgin females is to some extent dependent upon the courtship testing regime (Experiment 3). Most females tested with gonopodectomized males for 20 minutes per day had become unresponsive by the 6th or 7th day; receptivity of females tested at 3 and 6 day intervals declined more slowly but eventually reached the same level as fish tested every day. Testing females with intact males on the first three days resulted in a more rapid drop in female responsiveness. Ovariectomized females were less responsive and their receptivity waned more rapidly than intact females.

4. In Experiment 4, an attempt was made to determine whether the high initial responsiveness of virgin females was due to the fact that they had been deprived of social stimulation provided by males. Virgin females were tested with gonopodectomized males on eight consecutive days during which their receptivity declined to a low level.

Females were then isolated from males individually or in groups for 1, 2, 3, 4 or 6 weeks before being retested with gonopodectomized males. There was no recovery of responsiveness to a level typical of naive virgin fish in the previously isolated females. Any recovery of responsiveness which did occur was that which might be expected on the basis of each female having the potential to undergo a cycle in receptivity re lated to an endogenous cycle of approximately 20 days.

5. It is concluded that there is a cycle in receptivity in virgin females which reflects an endocrine cycle in ovarian activity. In addition, naive fish show an initially high level of response which is not, dependent on the immediate ovarian hormone state and masks the cycle regulated by the ovary. The responsiveness of naive fish habituates as a result of exposure to male courtship.

It is suggested that the interaction between the decremental effects (Habituation) induced by courtship and the incremental effects of ovarian hormone and short-term incremental affects of courtship may interact in a manner which adjust female receptivity to the social environment, terminating sexual responsiveness once insemination has occurred a number of times. ##

(Reprinted from "Livebearers" #18, Nov. 1974)

EGGS TOO WET?

by J. Phillip Beaver

Just recently I had a problem...a big $6.50 problem. A full pint of brine shrimp eggs had suddenly drawn so much moisture from the humid air that they were not hatching.

I thought the eggs were ruined, but one day, just casually mentioning the damp eggs to a friend, she suggested that I dry them out in the oven and try hatching them again. I thought this sounded ridiculous and completely impossible, but remembering the $6.50 again, I decided to try to solve the problem.

I preheated the oven to 200 degrees, turned it off and at the same time put the eggs in, which I had already spread out in a thin layer on a cookie sheet. The only heat which was applied to them was while the oven cooled down. I left them in the oven all night until all was cool I didn't think I should put the warm eggs in a jar because as this might cause steam and start the whole thing over again. The pilot light was just enough to keep new moisture from entering the oven and ruining the eggs.

The next day I dropped a teaspoon of eggs into a bag of bubbling salt water and twenty hours later turned it off. I couldn't believe it! I had the most perfect hatch of brine shrimp I had ever seen!

Maybe you already know about drying damp eggs, but if its new to you I hope it will be helpful. I'm not wishing too wet eggs on anyone, but if you have this problem...happy drying!

Note from "The Darter" editor: If anyone has checked the price of brine shrimp eggs lately, he knows that the $6.50 for a pint mentioned in this article has become much more, which makes this an extremely timely article now.

(Reprinted from "Tropical Topics, Feb. 1966 via The Darter", Feb.1975)

LENGTH OF FERTILIZATION FROM ONE IMPREGNATION

Summary of an article by Les Stokes

Observations were made in an attempt to determine how many broods the females would deliver after fertilization without further contact from a male guppy. All the females became gravid and gave birth to at least one brood. The young were removed immediately they were observed.

Female	Month						
	1	2	3	4	5	6	7
1	X	d	-	-	-	-	-
2	X	d	-	-	-	-	-
3	X	o	o	Rm	-	-	-
4	X	o	o	Rm	-	-	-
5	X	o	o	Rm	-	-	-
6	X	o	o	Rm	-	-	-
7	X	X	o	o	Rm	-	-
8	X	X	o	o	Rm	-	-
9	X	X	o	o	Rm	-	-
10	X	X	o	o	Rm	-	-
11	X	X	o	o	Rm	-	-
12	X	X	o	o	d	-	-
13	X	X	X	o	d	-	-
14	X	X	X	X	o	o	Rm
15	X	X	X	X	o	o	Rm
16	X	X	X	X	o	o	Rm
17	X	X	X	X	X	X	d

X = delivered brood
d = died
o = absence of brood
Rm = removed from test tank

By the 4th month, broods that were dropped were smaller in number, but it was still possible to distinguish a fish that had delivered young from one that was still gravid. The young in these small broods seemed larger at birth than guppies born in larger quantities.

Only one of remaining four females dropped a brood in the 5th month and five fry were counted in the brood. The same female became gravid once again and produced at least eight offspring.

From the results it appears that sperm from one fertilization can live for at least six months. The next question is what happens when there are fresh sperms competing against a sperm a month old?

(summary of article appearing in the "Fancy Guppy Association Journal", February, 1968, England.)

Sometimes we don't realize how wonderful today is until tomorrow.

GUPPY DIGEST

Controlling The Ratios Of Sexes Born To Guppy Females

In the November 1973 issue of the IFGA Bulletin we presented an experiment which controlled the relative numbers of males and females in a guppy brood by regulating the ratio of males to females in a breeding tank.

In the same November issue was an article, on the latest findings of the remarkable effect various lights have on the reproduction cycle and on hormonal release.

Now comes an amazing report that both guppy breeders and mink breeders in England have had remarkable success in producing more males and/or females by the use of colored lights. The way things are stacking up it should be at least worth a try to see if we can duplicate any of these experiments in our guppy tanks. If you want more and more males to put on the show bench, try a pink light if your strain produces beautiful show females, use a pale blue light to increase the number of females per litter. (But whichever you do, PLEASE let us know how it works.)

But coming back to the sex control experiments as reported in Peter Unwin's "Guppy World" column in PETFISH MONTHLY (May 1972, England). The success the mink breeders were having producing more males by using red lighting set one of Unwin's readers to a little experimenting of his own.

Replacing the normal 25-watt incandescent illumination on one of his guppy tanks with two red bulbs seemed to make no difference at all to his gups. But switching to two pink bulbs such as are used on produce the "coal effect" in electric fires, gave amazing results. In three successive broods with different females he found that about 75% of the fry turned out to be males. A fourth female produced 73 males and only 2 females.

He further found that the use of pale blue bulbs reversed the effect and gave a preponderance of females.

As Unwin comments: "Coincidence? Fluke? It is hard to say. Perhaps some guppy readers would like to try to repeat these experiments and report on their findings."

(Digested from the reprint of the original PETFISH MONTHLY article as it appeared in the "Guppy Gazette", April 1974)

Principles Of Filtration

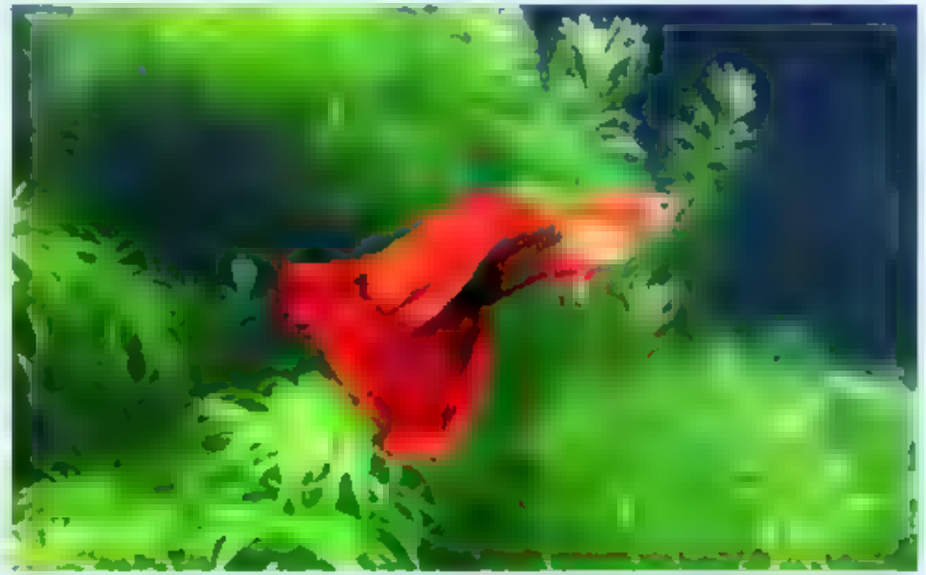
In order to fully understand the functioning of whatever form of filtration system you choose to use on your tanks,.. it is necessary to understand the basic differences between mechanical, biological and chemical filtration. Kordon Corporation has come out with a clear, simple explanation that should be helpful to all aquarists.

MECHANICAL FILTRATION involves the physical removal of particles suspended in the water. The porosity of the filter material determines the maximum size it will retain. The finer the material the smaller the particle it will remove from the water.

The best filter design would be to have the water flow first through several layers of varying sized filter materials with the coarser medium closest to the water intake so that larger particles are removed first and only the finest get down to the finest level.

Types of mechanical filtering materials include foam, synthetic polyester fibers, sand, gravel, charcoal, activated carbon, diatomaceous earth or any other material which will retain particles and prevent them from flowing back into the aquarium.

The International Fancy Guppy Association



IFGA EXTRACTS

BOOK FIVE

BIOLOGICAL FILTRATION is often not fully understood by the beginning aquarist. It is important for freshwater aquariums and is critical for saltwater aquariums. In freshwater aquariums, the bacteria cycle takes about two weeks to become completely established, but it takes 4 to 6 weeks for this cycle to become established in salt water aquariums for effective biological filtration.

When an aquarium is first set up, it does not contain many of the bacteria necessary for biological filtration. After a few days, aerobic (air breathing) bacteria begin to grow in the aquarium, settling in the sand, on the glass, and in certain filter materials. These bacteria are essential to a balanced aquarium because they do the work of biological filtration.

To survive, these bacteria need **food**, which they get from fish waste products. They need **oxygen**, which they get from aerated aquarium water, and they need **water flow** to carry the food and oxygen to them. Bacteria survive on several different surfaces, but they only thrive on certain ones. They thrive in sand if there is enough water flow from sub-sand filtration and under proper conditions they thrive in and on box filter mediums.

Biological filtration is the conversion by aerobic bacteria of proteins, peptides and amino acids into ammonia...ammonia into nitrites, and finally nitrites into less harmful nitrates. The process described in the following paragraph occurs in about two weeks in freshwater aquariums.

After the initial conversions are made to ammonia, there will be high concentrations of ammonia as fish deposit wastes in the aquarium. When sufficient "nitrosomas" bacteria develop colonies to break the ammonia down into nitrite, the high concentrations of ammonia will disappear.

Then for several days, concentrations of nitrites will be excessive, until colonies of "nitrobacter" bacteria are formed which will break the nitrite down into less harmful nitrates. After the "high nitrite days" have passed, the biological filtration process will keep the nitrite level below one part per million and the fish will not be endangered unless the bacteria are removed or killed.

Cutting off the bacteria's supply of oxygen and food will kill them, and dead bacteria could possibly harm or kill the fish. Sudden increases in ammonia or nitrite can be harmful because there may be insufficient quantities of the necessary bacteria to make the conversion.

For right cleaning of filters, wash them in water taken from the aquarium so that some bacteria will remain alive. When placed back into the tank these bacteria will act as a starter colony and the bacteria will quickly become re-established to full strength. For a thorough cleaning, rinse with warm or hot water, then with cold, and all of the debris and slime created by the thriving bacteria will be readily removed. Cleaning in this manner kills the bacteria and it will take time to recolonize.

CHEMICAL FILTRATION changes the molecular structure of water, thereby removing specific chemicals which cannot be removed either mechanically or biologically. Charcoal (to a lesser degree) and activated carbon chemically filter by **adsorption.** Both have surfaces that are positively charged, so negatively charged molecules and ions adhere to their surfaces. Adsorption removes negatively charged organic compounds, certain ions (such as copper, zinc, iodine, etc.), odor molecules, gill molecules and waste molecules. The adsorption capabilities of the material determines its effectiveness as a chemical filtering material. Other chemical filtering materials include ion-exchange resins and aquarium peat.

Activated carbon has a high adsorbing capacity but is less efficient as a biological filter because the surface cavities are much smaller and do not support as many bacteria. It also is less effective for mechanical filtration as it does not have as complex an interlocking effect. Ideally, the two should be used together. Only small amounts of activated cabon are needed, as it has tremendous adsorbing capacity. Use of larger quantities than about 1 tbsp. per 50 gallons can change the organic quality of the water so quickly that it can cause stress in the fish. It may also initially remove some of the oxygen in the water, but proper usage produces no adverse effects. Activated carbons should not be used when more acetic conditions are desired because, in removing organics from the water, it tends to increase the pH. Charcoal, on the other hand, has only a mild chemical filtering effect so large amounts can be used without too extensive an alteration of the organic water quality.

To determine when this material has few drops of methylene blue in the tank. If this blue is not removed adsorbing capacity has been depleted. Just as adsorbing capacity, put a aquarium to give the water a bluish by filtration within 24 hours, the activated material should be used.

Ed. note: Because of the water changes occurring when changing or cleaning any filter, it is advisable never to change water and filters on the same day. It is helpful to run a used filter for a few days in a newly set-up tank.

GUPPY COLLECTS LIFE INSURANCE

OKLAHOMA CITY (AP) - After Fred Finn Mazanek gasped his last, Globe Life & Accident Insurance Co. paid off...but not before trying to wiggle off the hook. After all, Fred was just a guppy.

The whole thing started last year when Globe Life offered Stan Mazanek, then a senior at the University of Arizona, a special, once-only student discount life insurance policy. For just $1, the company offered, the insured could purchase a $5,000 policy good for six months.

Mazanek, 24, figured to be around longer than six months so he decided to sign up his guppy, Fred Finn Mazanek. Before sending in the application, Mazanek made sure to answer all the questions accurately.

Age of insured: "6 months."
Weight: "30 centimeters."
Height: "3 centimeters."
Good health: "Yes"
In the Military service: "No"
Relationship of beneficiary to insured: "Owner"

Mazanek figured Globe Life would return his check, but instead it issued policy No. 326,057. So when Fred died, Mazanek notified Globe.

That's when Globe took a closer look at the application. A special representative was sent to Tucson to see whether Mazanek was the kind of man who would take advantage of a "clerical error."

"Yes," said Mazanek.

No jury would award $5,000 for the death of a guppy the Globe man argued. Mazanek offered to settle for $1,000. "Not a penny more than $650," the Globe man replied. Mazanek said no, but then reconsidered and accepted.

Mazanek said he used part of the settlement to buy two more guppies and a fish dinner for his family.

Globe Life president John N. Singletary was reached at a fishing lodge where he and other company executives were meeting. "It's sort of funny, you'll have to admit," Singletary said. "You know, we mass-produce these policies and have about 340,000 of the in effect."

"He put a strange name on there for a fish, and our computer just isn't trained to catch fish. I guess you could say." :-)

HINTS FOR SUCCESSFUL BREEDING

By Ken O'Hara

(This article may not be reprinted without the written consent of the author)

Breeding outstanding guppies presents a demanding challenge. In general, it is hoped that like will produce like: that breeding to males that are strong, where the females are weak, will result in improvement; that the parents will be prepotent (pass desirable characteristics uniformly on to their offspring).

The main intent of this article is to help breeders understand what is most likely to happen when certain systems of breeding are used. All of you, at one time or another, have referred to systems of breeding such as outcrossing, inbreeding, linebreeding, etc. You may have heard that a particular breeding system has been very successful with a given breeder. The biggest error that a guppy breeder might make would be to decide that only one system of breeding will work with his strain. Actually, there is a time, place and situation when almost every breeding system can and should be used in breed development and improvement.

There is nothing about any one system of breeding that guarantees success or that foredooms it to failure. Whether or not a breeding system fails or succeeds depends on several factors. These are the factors of inheritance: the genes that are present in the stock to begin with, and the chance transmission of a large proportion, or small proportion, of desirable genes from one generation to the next, and the amount of selection practiced by nature and by man for genetic desirability and against genetic undesirability.

The guppy breeder has two main tools with which to work in putting the inherited factors together in desirable and efficient combinations....the selection and the systems of breeding. Both of these tools must be used intelligently for maximum strain improvement.

In general the purpose and uses of the main breeding systems can be simply stated as follows:

OUTCROSSING

Purpose:

1. To bring in outside desirable genes.
2. To cover up or replace poor genes already present.
3. To maintain or increase overall vigor by promoting gene differences and interactions.

Who should use this system:

1. The beginner, average and slightly above average breeder should outcross most of the time.
2. Occasionally it can and should be used by the most constructive breeder with the best male groups so as to add a particular strong factor that may be lacking. Care must be used in doing this because something undesirable may come in at the same time.

ROTATIONAL MALE USE

Purpose:

1. To increase overall productivity and vigor by making for maximum gene and differences and interactions. And adding desirable genes.

Who should use this system:

1. Breeders who have several relatively pure strains which exhibit varied but desirable characteristics. The main purpose would be to combine the most desirable traits from the various strains.
2. Breeders who have limited tank space. That is, cross desirable strains from other reputable breeders with your own in order to achieve a specific goal.

CROSSBREEDING

Purpose:

The same as rotational male use,....to make for maximum vigor.

Who should use this system:

Anyone who is unhappy with what he has now, but who must breed this way out of trouble rather than buy bass - out of it.

INBREEDING AND LINEBREEDING

Purpose:

1. To make for greater genetic purity and prepotency.
2. Expose weak spots for culling.
3. To render a parent strain more useful when used in all other systems of breeding.
4. To make the very good and best, better.
5. If poor genes are present, increase the likelihood of their discovery.

Who should use this system:

1. The most constructive, most critical, most selective breeders, whose fish are generally considered superior.

How much can it be used:

The better the genes are to begin with, the more it can be used, and vice versa. An improved, selected, high-yielding inbred is particularly desirable for use in all other systems of breeding.

In conclusion, it can be seen that inbreeding and outbreeding simply increase or decrease the likelihood of similar genes pairing together. The results obtained depend on the quality of the genes in the population at the start. It can further be seen that these two breeding systems INBREEDING and OUTBREEDING, either increase or decrease genetic purity.

The important thing to recognize is what INBREEDING and OUTBREEDING are likely to do.

GUPPY GENETICS

PART VI - BREEDING TECHNIQUES

by Jack Rosengarten, Active PPGA Member

Let's take a look now at some of the techniques of breeding guppies. I hope that this series has convinced most of you that the best method, although sometimes impractical for a particular breeder, is to isolate one male with one virgin female and to isolate their offspring until they mature. This offers an opportunity to be sure of the parentage, what they looked like, and of course, what the results were.

Quite often breeders will use a method known as population breeding. This involves putting several of the best males and females together and allowing all the fry to mix. The next set of breeders is selected from the fry population. The advantage of this method is that precious time is not lost if one of the fish is sterile, dies, or turns out to be a poor choice. I'm sure that many breeders also feel that they will also get many more combinations than if they pared off the fish in separate tanks. The disadvantages of this method, however, are legion. It should be pointed out that isolating each female and then her fry will only guarantee who the mother is, there will still be multiple fathers. Of course, if the males in this situation look very much alike, this would be an improvement, since the female (if you're breeding show males) is the largest unknown factor.

It has been pointed out that quite often the odds against selecting the best female, when breeding for male traits, are usually pretty large. If the probability of selecting the best female is one in four, then the chances of selecting the two best females is only one in sixteen, and of selecting the three best is only one out of 64. In other words you may be lucky enough to choose the best female if you choose only one, but trying to select several, and mixing their fry will be almost sure to dilute the results. Likewise, if several males are used the chances are that only one of them will do the mating, and unless they are perfectly matched, you can be sure it's the smaller one with the smaller fins. This is not some perverse Murphy's Law (if there's a wrong way it will happen), but an example of Darwin's survival of the fittest. Whenever guppies must compete, whether it is for a mate or for food, the ultimate result will be reversion to the wild type.

Since I work with a small number of tanks, I've been forced to compromise between the two methods and have evolved a number of rules which are presented below.

1. Start with your best male and several females. If the female candidates do not look like each other be sure to select one of each type unless you've already decided on the best female type. If the females are not heavy in three weeks, add another male.
2. Remove each pregnant female to a separate tank to deliver her fry. As available tanks permit, keep each set of fry separate. Make sure you have classified the mother and can still identify her if she is to be mixed with other females. This will be important if she is to be used for back-crosses. Some breeders snip off a piece of the caudal to mark her.
3. Continually use new brood females, obtaining them from the matured fry. Using the same female over and over will never improve the strain. I usually keep only one or two litters from a female and then retire her. The females are not put back with the males.
4. If space is not available for keeping several litters of fry separate, keep at least the most promising one separate.
5. As the separated litters mature, compare them to the mixed population. If they are worse dump them, don't mix them back into the population. If they're better, dump the population and make the best litter the source of your new breeders.

6. Separate the male and female fry as soon as possible. This will assure that the females remain virgin. Since the females can carry the sperms for months after a mating, a mated female can ruin a breeding program. It is possible for a female to be impregnated even before she is fertile. In some strains the first indications of sex are when the males start to show color. In other strains the first indications are when the females start outgrowing the males. Be careful not to leave a slow growing male with the females. Some breeders claim they can sex babies that are a few days old by observing the shape of the swim bladder.
7. The new stud males can be chosen from any of the litters. The brood females should be selected from the litters that have the highest percentage of desirable males even though the best males are not in the same litter. Of course, you will want to back-cross to the original sire if he is still the best male.
8. Above all, be sure that immature males are not allowed to mate. They are an unknown quantity until fully mature. Occasionally you may want to breed a promising young male early, but have the courage to admit it when a mistake is made.
9. Cull early, but wisely. Sometimes the ones that mature the slowest are the best. Learn the characteristic color changes as the fish mature so that you will know at the earliest if the desired results are forthcoming. Make note of how many you cull and why, since this is an important statistic. If you're trying for a particularly hard combination, it might be prudent not to cull until all have matured. Perhaps what you're trying for is linked with small size or some other trait you consider undesirable. It also may be a rarity and you may miss your only chance.
10. Never breed a deformed fish. Although my experience has been that most deformities can be traced to environmental factors, enough are hereditary to bar taking chances. Remember that inbreeding concentrates not only the good genes so that every opportunity should be taken to discard possible bad genes.
11. Achieve the harder goals first. That may sound backwards, but what I mean is that you will frequently have to choose between breeders that show some but not all of the desired traits. Let's say you have to choose between a small male with perfect dorsal color (matching the caudal) and a male that is larger with poorer caudal color. Although size gets more IFGA points, the color match is harder to achieve. Later breeding can probably gain back the larger size.

Remember, the above rules are a large improvement over population breeding, but are no substitute for the breeding of selected pairs and the separation of all litters. If you're trying to improve more than one strain with a limited number of tanks, it may be wise to dedicate most of your tanks to one strain at a time while only maintaining the other strains.

Now some words on selecting the females, assuming that your goal is to raise male show guppies. In most cases, the females will not display the traits that you're trying to establish in the males. Body colors and X-linked half black patterns are the notable exceptions to this rule. The usual advise when breeding for deltas is to select short, thick females with large dorsals and wide caudals.

The major trap that many breeders fall into is that of double selection. Simply stated, this is attempting to select both the males and females for their good looks. All the genes of a guppy are located on only 23 pairs of chromosomes. Selecting a female characteristic may assure that you exclude a desired male characteristic.

My own experiences bear out the pitfalls of double selection. When I started purifying my double-sword snakeskin line from a strain which also produced veil-tail snakeskins, I selected females with caudal patterns that suggested double-sword snakeskins. As the line deteriorated, I finally realized that my best results were coming from matings with females that had clear caudals and that is what I finally used. When I was trying to establish a red delta line, I chose females that showed some red in their caudals but finally formed the opinion that my best results were coming from females with black caudals. I now am trying to establish a red snakeskin line which started as a cross between a red delta female (black tail) with a veil-tail snakeskin. In this case the females have red caudals and seem to give better results than the black caudaled females in bearing red snakeskin males. It is possible that sometimes the genes that express a color in the male may not express the same color in the female and that a female with the same color may have it due to a different pair of genes. Usually the case is that the hormonal differences suppress the color but sometimes there might also be a sex linked modifying gene which is missing in one sex or the other.

What must be done is to classify your female fry as well as your male fry. Look for basic differences. They may include fin shapes, body proportions or color markings. When you select your first set of breeders make sure that you choose at least one female from each type. Check the next generation of females in each litter. Do the female fry look more like their mother and the males less like their father? If so, it may be a coincidence, but it may also be significant. Do the sisters from the different types of females show the same segregating of female traits or is some trait starting to become more prevalent? Is one sister high in one female trait and low in some male trait while the opposite is true in another sister? By answering these questions and looking for trends you may be able to speed up attainment of your breeding goals.

Many breeders swear by what they have found to be successful for them. Some say the female's tail shape must be round, or square, or shark like. They like the color to be clear, or black, or whatever. They're usually right when it comes to the strain they're working with, but to apply it to other strains is often wrong, as the examples above illustrate.

In choosing the females it is also obvious that some special decisions must also be made. Females with small dorsals and caudals probably won't have sons with large dorsals and caudals. Similarly, if you want males with solid color tails, choosing females with spotted tails will probably be a mistake. Also females with dorsals that don't match the color of the caudal will probably have sons with the same characteristic.

In a good strain the females will all start to look alike, especially if the breeder is working toward that goal. This doesn't necessarily mean that the females' appearance is contributing to the males' appearance, it may mean that the breeder has found a "safe" set of chromosomes that will at least not detract from the desired goal.

Although all of the preceding has favored the breeding of show males, they are equally applicable to the breeding of show females. In fact, the danger of making an unwise double selection is more prevalent since the males display considerably more than the females. Good show females have long slender bodies while, as previously mentioned, short thick females are recommended for breeding de tamales. So perhaps the smaller males would be best if you're after show females. I recall at least one breeder writing that he discovered that he was culling his best breeding males from his show female strain. Most guppy strains have either show quality males or show quality females but not both. The half black strains are a notable exception to the above as some produce show winning males and females in the same strain.

Which breeders to choose is something that you must determine by trial and error. I hope that this article has provided you with some of the necessary tools to make those decisions.

Reprinted with additions from the Guppy Roundtable of January, 1974

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HYBRIDIZATION

by Bob Fisher

The dictionary defines the word "hybrid" as being "the offspring of two animals or plants, of different races, varieties, species etc. Anything of mixed origin." If we look at the modern fancy guppy with this definition in mind, we must conclude that almost all fancy guppies are hybrids, because there are few "pure" strains around today. Such strains as do exist are to be greatly valued for their breeding potential in creating new hybrid varieties.

Every time a breeder puts a pair of guppies together for breeding, he is conducting an experiment in genetics and heredity. If the two fish are from two different strains he is creating a hybrid. His hope is that the good features of each parent "strain" will be combined in a single hybrid line. Sometimes he is lucky and the fish that emerges as the result of a random cross is much bigger and better than either of the parent lines, but all too often the result of a random cross is degeneration and reversion to wild features. The difference in the outcome of course, depends on the quality of the parent stock. Many beautiful fish are offered for sale and claims to be "strains" the buyer having no proof other than the assurance of the breeder selling the stock. They cross this new "strain" with their careful ly produced stock only to be disappointed when the hybrids fail to measure up to their expectations. Instead of a handfull of guppies displaying every characteristic from "a" to "z".

Genetically, this mishap can be explained as follows. If a pure strain "AA" is crossed with another "pure" strain "BB" the resultant hybrid individuals will be "AB". Every single guppy in the mating will inherit a complete set of "A" chromosomes and a complete set of "B" chromosomes from one or the other of the parents. Thus it can be expected that in the first generation, all of the hybrids will be "AB" individuals and should look alike and possess similar characteristics. They should all possess the same color, even though the color may not necessarily match either of the parent strains. So here is one way to test the purity of a strain. If the first generation individuals look alike, it is pretty positive proof that the parents came from fixed strains. If the guppies in the first generation hybrid cross give about 50% of one type and 50% of another type it can be deduced that only one of the parents was from a fixed strain and the other was itself a "hybrid". To illustrate, let us consider mating an "AA" individual to a "BC" hybrid. The result of this mating will produce 50% "AB" hybrids and 50% "AC" hybrids.

Now, if we follow the same line of reasoning and deliberately cross two hybrids, it is possible to get that handful of junk where almost every individual is a "mongrel". To illustrate, suppose we mate an "AB" individual to a "CD" individual. The following possible combinations of chromosome packages can occur: "AC", "AD", "BC" and "BD", roughly 25% of each. Now each of these new combinations could be a superb new hybrid, but adversely, the reshuffling of genes could bring about the reversion to the old stock so often witnessed. The chances of success or failure run about 50/50. Again, success depends on the quality or "purity" of the parent strains "A", "B", "C", "D".

Now this is all theoretical and does not take into account the fact that approximately 10% of all guppies are mutants, meaning that genetically their composition has changed very slightly either by a crossover in the chromosomes, or the mutation of some genetic material (a mutated gene) or the loss of some genetic material (a changed or destroyed gene). If we consider these factors playing an important role, as indeed they certainly do, it is conceivable that in addition to producing 4 basic varieties from crossing two hybrids, we will also have included a small percentage of mutants to further confuse the picture.

Unfortunately no guppy breeder has a crystal ball, and is able to fully predict the outcome of a particular mating unless he is "line breeding" fixed strains where it is much more possible to call the shots. This then points out the importance and value of the fixed strain. If any line of guppies will consistently deliver 90%

or better individuals all possessing the strain features, then one can assume he has a fixed strain, and can also assume that this strain will continue to produce its like in successive generations providing the small percentage of mutants are not allowed to break the genetic inheritance.

Deliberate hybridization of fixed strains is a very worthwhile practice. Many prominent guppy breeders produce their best show stock this way, mainly because hybrids have renewed vigor and generally grow considerably larger than the fixed strains which produce them. I call to mind an experience of about 15 months ago. I obtained a fixed strain "yellow" female from a prominent breeder having no male to go with the female I was forced to breed her to one of my own lavender mosaic-color males from Fl strain which was only four generations old. The hybrids this pair produced were the best I have yet produced for size, color and show quality. The color of the hybrid males was a red, white and black mosaic-color with the red predominating. The vinnage, however, was far superior to either of the parent varieties and thus these fish for a short period, claimed several prizes in the show circuit. I then tried to line breed these fish and could not duplicate the effort, the offspring were a miserable concoction of everything from "a" to "z".

However, going back to the original strains and producing the first generation hybrids, I again call the trick. Thus, in order to produce these outstanding hybrids, I am forced to keep two additional parent strains in order to provide breeders for the hybrid line. This is not a new experience, many breeders do the same thing. I record it mainly to illustrate the fact that "hybrids" have to be produced randomly but with some effort and forethought. Hybridization can be very worthwhile, but caution should be exercised by the novice. I believe, that before one undertakes to produce a hybrid, it is essential to know the genetic construction of the breeders.

It is seldom one visits the home of a first rate breeder without seeing these types of breeding experiments taking place. I usually have at least a half a dozen crosses going in order to assure future show stock. However, for every ten of the crosses I try only one will be successful and give me what I was after.

The fact that hybrids are only good for one generation causes problems in that so many parent strains must be maintained in order to assure future breeding stock for the successful hybrid lines. The most practical way of achieving a consistent supply of hybrids is to carry on only one or two parent strains. If one then retains a few virgin females from these strains, he has a ready supply to mate with any promising male he can procure from other breeders.

I find it fascinating to watch how different gene combinations can produced different effects in the hybrid offspring. But, while hybridization is interesting and important for the future of the guppy, it is the maintenance of the "pure" strains, which will assure genetically correct material for hybrid mating.

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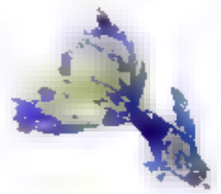

ADVANCED GUPPYIST PANEL - PROJECT I

THE TECHNIQUES OF BREEDING SPECIFIC COLOR VARIETIES

Section 6 - BREEDING THE YELLOWS

Yellow Strains Represented

#1 Developed from a red variegated inbred strain by breeding a yellowish male back to his mother for color approximately seven years ago. (Stan Shubel)

#2 Purchased from Shubel multi stock which threw a few yellows (about five years ago) (Ron Yater)

#3 Pure German yellow males direct from Germany. As no females of the strain were available, crossed to Full yellow snakeskin females and grey-bodied females from Half Black Yellow strain about 5 years ago. (Midge Hull)

#4 Trio from Ron Yater's F-2s. Worked pure since (J.G. Fitzstrault,

#5 Developed in my fish room through three years of selective breeding. William Ing

The fact that the yellows are one of the more newly-developed guppy colors is obvious from the above backgrounds. Only one of the strains reported on began from a pure yellow strain. #3 started with males of a pure, well- developed German strain but had to go to an outcross due to the lack of females of the same strain, so it cannot be termed an established strain at the beginning either. The other strains have all been recent developments with 1, 2 and 4 all descending from the same Shubel stock.

FEATURES OF THE STRAINS AS COMPARED TO AVERAGE (blank space = average)

	#1	#2	#3	#4	#5
Size		smaller	smaller		smaller
Tail width	wider		wider*2	wider	wider
Dorsal	bigger	bigger	bigger/smaller*3	bigger	smaller
Rate of growth	faster	faster	faster		slower
Rate of maturity	earlier	earlier	earlier		later
Fertility				more	less
Cannibalism		less	less	less	more
Susceptibility to disease		less			less*6
Deformities			less	more*5	less
Stronger/weaker			stronger*4		
Other	*1				

*1 Tail is easily frayed
*2 70 to 80 degrees common
*3 - Get both extremes
*4 Much more active, Longer-lived under normal conditions
*5 Bent backs
*6 - Seem to be disease free even from tail rot

It is interesting to note the close similarity between features of different yellow strains. That would be expected of 1, 2 and 4 which all derive from the same stock, but 3 and 5 which are completely unrelated to the others, also show many of the same traits. Yellows in general seem to carry wider than average tails (4 out of 5). They tend to be smaller in body size (3 out of 5), faster growing and earlier maturing. While #5

reports his yellows as slower-growing and later maturing, this delayed development does not seem to bring the size up to average although he adds that they are "only slightly smaller when from a good dropping." Yellows also seem to be hardier strains, less susceptible to disease and, in general, showing average or less than average numbers of bent spines. This is a good example of how desirable or undesirable characteristics can appear out of the same strain under different breeding programs. Obviously #4 was not breeding for bent spines, but perhaps the factors he was seeking in his breeders led to the selection of breeders which were more prone to this fault, and the constant inbreeding made the undesirable characteristic more pronounced.

BREEDING TRUE

#1 Started out as a newly-developed color from an established inbred line. Breeding the yellowish male back to his mother was apparently successful in setting the color as he reports the first offspring were like the parents. After seven years of working this new strain to offspring are now fairly uniform with 70% of the desired color and 30% with light, whitish tails.

#2 Started with the Shubec multi stock which threw some yellows. His first breeding did not produce all yellows, but rather a mixture of multis and only about 20% yellow. After 5 years of work he reports that he has gradually worked the strain into throwing about 90% yellow.

#3 Started with pure strain yellow males from Germany outcrossed to females from a strain of yellow-tailed snakeskins (in which the female does not carry the snakeskin pattern). The first generation produced both yellows and multis. After about 2 years of working with the resulting hybrid 'strain', another pure strain yellow male was obtained from the same German breeder and was used as a back-cross into the original strain. This served to intensify the yellow color and to widen the caudal even further. After 5 years of working this strain the results are still somewhat varied with the biggest difference being the depth of yellow color (from whitish to deep yellow) and the presence of red on some of the male caudals.

#4 Started out with the F-2 generation from #2 strain. He reports that the first young were like their parents. Present young are somewhat variable with about 40% of the desired-color, 60% with color impurities and 30% of a different color, the main problems being a lot of red and white in the caudal.

#5 Developed his strain himself and reports "over the three years selective breeding and luck have brought my yellows to their present stage of development. The yellow color seems to be growing stronger with less green appearing, but not always. Some droppings have spots in the tails of some fish, but less as time goes on. Green and yellow of a pastel nature show up. I now get about 50% yellows and 50% a pastel green. The females are showing much more color in the tail, with quite a bit of yellow."

Strain	Time kept	Siblings	% of desired color	% with impurities	% different color
#1	7 years	somewhat varied	70%	30% *1	
#2	5 years	fairly uniform	90%	10%	
#3	6 years	somewhat varied	70%	30% *2	
#4	7	quite varied	10%	60% *3	30% *4
#5	3 years	fairly uniform	50%		50% *4

*1 - light whitish tails
*2 - with red and/or white
*3 - a lot of red and white
*4 - pastel green

Considering that yellows are fairly new developments they seem to be progressing rather quickly when you compare the percentages that are coming out the desired color, with percentages of desired color reported in the red section. However, it should be mentioned here that black spotting has **NOT** been included as an impurity by these yellow breeders. "Desired color" in this section means that the **BASIC caudal color** is yellow. Under present (1974) IFGA classifications this is all that is required of a yellow. Solid yellow, of course, would be preferable, but there are so few of them that basic yellow with black spots is what makes up most of the yellow classes on the show benches. The reds, on the other hand, would have been able to report almost 100% of the 'desired color' if they had been evaluated the same way, but solid red (unlike solid yellow) is fairly common, therefore breeders of reds include any black or dark markings as "impurities". Yellow breeder #5 is the only one of these above breeders to report obtaining yellows that are totally free of black spots in the caudal. Undoubtedly solid yellows are coming, but at present it should be remembered that most yellow strains do have varied amounts of black spotting in the caudals.

What Do These Breeders Do About Color Impurities?

#1 Maintain several related lines and use selective breeding.

#2 I don't have too much trouble now, but I still have to pick breeders very carefully.

#3 Careful selection of males used for breeding. Look for depth of the yellow color and a total absence of red. Females are more difficult but I avoid any that show the least pinkish cast to their caudals.

#4 I'm still looking for a solution.

#5 Select fish showing the greatest amount of yellow.

It's the same old story of **'highly selective breeding'** that is required to maintain and improve the yellow color. To even maintain the yellow color the breeder, not the male guppies, must make the breeding selections and he must make them carefully. The yellow strains are still too close to their mixed backgrounds to use the 'commonly' breeding methods which breeders of more securely set strains can get by with (though not for long!).

Environmental Factors Affecting Yellow Color

#1 none stated.

#2 none stated.

#3 Feeding carotene is tremendously effective. Even the whitish creams turn deep yellow and, even more important, the fish cannot "turn the color off" (a trick yellows are well-known to do when disturbed or frightened). The length of time the deep color remains is directly dependent upon the length of time it has been fed to them. Flake yeast also increases the yellow color. Both are fed mixed with dry food and are well received by the fish.

#4 My results have been good using Midge's "yellow" food (as described above).

#5 Natural sunlight with sun rays screened out throughout their entire life.

Experiments elsewhere have also shown that feeding dried, powdered marigold petals also increases the yellow color, but as the fish do not like it they have to be forced to eat it by virtual starvation. When used long enough, the entire fish becomes yellow. There have been reports that the "golden trout" from the Orient have been developed this way. Marigold powder has also been commercially fed to chickens to make the flesh a more palatable (?) gold instead of pinky/white.

Methods Of Breeding To Maintain Or Improve Color

	#1	#2	#3	#4	#5
INBREEDING	x	x	x	x	x
Sibling cross	x	x	x	x	x *1
Mother/Son cross				x	
Father/daughter	x		x	x	
LINE BREEDING	x		x		x
No. of lines kept	4		3		?
Crossed after how many generations	4		5-6		1
Controlled hybrids					
Cross to different body color					

#1 - In order to get enough babies I select the best males and females and tank breed them in a 10-gal tank with about 18 fish. This must be done at about 2 months of age (Note: #5 reported problems with less fertility)

Inbreeding and linebreeding remains the preferred method of maintaining and improving color in the yellows. This is to be expected with still developing strains. It should be noted that #5 is using a slightly different linebreeding approach than usual as he reports crossing the lines after 1 generation. This would, in effect, be continued crossings of 1st cousins. The same breeder has also been forced by fertility problems to group breed selected males and females at very young ages. In fact as "soon as possible". This puts him at a disadvantage as he must breed before the fish have developed all their desired (or undesired) characteristics. Since he is making good progress in spite of these drawbacks, he must have been able to discover 'key' factors that show up at a very early age which allow him to make a wise selection of breeders, or he has made better friends with Lady Luck than has the average breeder.

Methods Of Breeding To Maintain Overall Quality Of The Strain

All breeders reported using exactly the same breeding methods as outlined under maintaining and improving color. Here again, this is not only logical but probably the only way to go with strains that are still in the process of being set. Inbreeding and linebreeding are vital if a strain is to be set for a new trait, in this case the new trait being yellow color.

Methods Of Breeding To Produce Show Fish

These breeders make no special breedings to produce their show fish. The yellows they show come from their regular inbreedings and linebreedings. Breeders of more securely set strains (blues, greens, etc.) often report making crosses between two unrelated strains of the same color to produce larger hybrids for show purposes. With the newer strains, such as the yellows, there simply are not enough pure strains around to make this work. Probably the biggest single factors against success in outcrossing yellows would be the unstableness of the yellow strains and the lack of compatibility between different yellow strains. There are still too many unpredictable genetic factors present in the different yellow strains.

There is not even any guarantee that any yellows at all would come out of a cross between different yellow strains (see following chart).

Outcrossing ....the effects on color

Yellow X...	Results
Blue	#1 - Good results (no colors listed)
Green	#1 - Excellent (no colors listed)
Red	#1 - Fair (no colors listed) #3 - Fair, red bicolors and red/yellow/white multis
Multi	#1 - Excellent (no colors listed) #2 - Fair, only pale colors on the resultant multis
Purple	#1 - Excellent (no colors listed)
Half/Blk.	#1 - Cross to H/B Red, excellent (no colors listed) #3 - Cross to H/B Yellow. Excellent. Beautiful Half/black females. Half/Black Bicolor males of very high quality. Caudals yellow with black patterns.
Another yellow	#2 - A percentage of color from both strains. Better size on both. #3 - All F-1 came out green or green/black bicolor. F-2 were mostly green/yellow bicolors. No yellows.
Albino	#3 - Albino was related as came from same strain as females used to start yellow strain. F-1: yellow tails. F-2: yellows & yellow-tailed albinos. Lost some dorsal size. Tails frayed more easily.
Snakeskin	#3 - Poor to excellent snakeskins with yellow tails. Some of very high quality but many with uneven tail growth.

There are not enough details given as to colors of fry resulting from the various outcrosses on which to base any kind of deduction. #1 seems to have produced excellent quality fish from several outcrosses although he does not say what color classifications they would fall under. Outcrossing yellows to reds does not seem like a good prospect as neither of the outcrosses reported here were rated very highly (in the section on Breeding the reds, there were also no successful red/yellow crosses reported and one was rated merely as "junk"). As has been the case in most other sections, once again outcrosses to Half-Blacks are so universally popular that almost every guppy breeder has some kind of half-black in his fish room somewhere!

If All Of The Strain Were Lost Except One Lone Male... What Would Each Breeder Consider To Be The Best Outcross To Make To Preserve The Color?

#1 Light AOC (we presume by AOC he means a pastel white or cream) because yellow color is somewhat recessive. Results expected would depend on the female used.

#2 Another yellow, if one could be found, for a crossback. If not a yellow, maybe a green female. I would expect yellows from a yellow female and both greens and yellows from a green female.

#3 A female from a Half-Black Paste strain, preferably a grey-bodied female from a H/B Paste strain that throws grey-bodied females... (would expect a) grey-bodied males with good

yellow to whitish tails), or if no grey-bodied females from a H/B Pastel strain available, to a H/B female from a H/B Pastel strain. Would expect either 50% or 100% H/B yellow males and females in the F-1 (depending on whether H/B female carried the H/B on one or both of her X-chromosomes). Breeding a grey-bodied yellow male to sibling F-1 females would give at least 50% free of Half Black in F-2. Would expect all caudals to be cream to yellow, probably with black patterning

#4 Half Black Yellow Female. I would expect Half Black yellow with black spots on cauda and yellow mottled with black spots on the tail

#5 Albino because I feel the recessive traits in albino would allow me all yellow males and females...but the albino females would have to be good ones and should have yellow color

Although the various breeders have made different choices of outcrosses they believe would best let them continue with a good yellow color after such a hypothetical disaster, they do all have one important thing in common...they have all selected outcross strains that have a minimum of any caudal strong color. The only somewhat strong color mentioned was #2, whose second choice would have been a green. What this adds up to is that these breeders have found the yellow color to be quite recessive to most other colors and easily lost if stronger, more dominant colors are introduced. In the case of green, many greens are in themselves quite recessive as to color (but not all...see Section 4 on Breeding the Greens) so should be easier to overcome in future generations of a yellow-green cross. It should be specially noted that, nothing with the least bit of red has been suggested. Since many of these breeders have had difficulty eliminating red from yellow strains, it is natural that they should shy away from ever purposely throwing any red back into their yellow strains.

Breeding Goals

#1 Improving color and increasing strength of cauda

#2 A true-breeding color and better size

#3 Bright yellow caudal with matching dorsal and better body size. Would like to eventually eliminate all black and have pure yellow color

#4 I would like to develop a completely pure yellow dorsal & cauda

#5 Intensifying yellow, increasing body and dorsal size

Increased color and size seem to be where most of the work with yellows is aimed, but eliminating the black spots is also being worked on. Eventually there will probably be strains of pure yellows that are as solid color as now exists in reds, blues, greens, etc. #5 has already reported solid yellows and more are bound to come from other breeding programs as more yellow strains become set as true-breeding strains, thus allowing the breeders to concentrate more strongly on the purity of the color.

Selecting Female Breeders To Further Particular Breeding Goals

#1 By caudal shape, the spread of the caudal rays,, body shape and the C/R ratio

#2 Body size and shape with a good C/R ratio. A wide, shark-tail caudal that is clear with no spots. Good size and shape to dorsal

#3 A large caudal that leaves the peduncle at as wide an angle as possible and is of bright yellow color with no black spots. Good body shape with a thick, stubby peduncle, a good C/R

#4 Body size and shape with a good C/R

#5 Large, well-formed body with a yellow cast. Yellow in the cauda

TRAITS LOOKED FOR IN FEMALES

	#1	#2	#3	#4	#5
C/R Ratio *1	x	x	x	x	
Body size		x		x	x
Body shape	x	x	x	x	x
Body color					
Caudal shape	x	x	x		
Caudal color		x	x		x
Caudal size		x			
Dorsal shape		x			
Other					

*1 - see Section 1, Breeding the Blues, Page 6 as to how to measure the C/R ratio...which has to do with length to width ratio of peduncle area

Breeders of yellows are unanimous in looking for good body shape when selecting females for breeding their strains, and 4 out, of 5 look for a good C/R ratio (the wider in comparison to the length, the better). Next to the body shape and C/R, the caudal shape and color and the body size are considered most important. It is interesting to note that when selecting female breeders for yellow strains 4 out of 5 pick their females for only a limited number of highly selective traits. This reflects the necessity of concentration on specific factors while a strain is being developed and set...first things first. Later, when these major factors of the strain are more securely set and producing a higher degree of uniformity, then more attention can be given to secondary factors. This is already happening with #2...the breeder who reports the highest degree of uniformity from his strain. It should be noted that #5, who is forced to breed his females at 2 months due to fertility problems, has found that at that age body size and shape and caudal color are the best clues.

Selecting Male Breeders

#1 Body size, shape and color, caudal size, shape and color, dorsal size, shape and color

#2 The biggest male with good shape and good all around proportion. The caudal should be big with straight edges and be as clear as possible of spots. The dorsal should also be clear of spots and be a good shape. Also look for late development in the male

#3 A well-shaped colorful body that is as large as possible. A wide caudal that is at least as long as the body and with deep yellow color that has the least black spotting. The dorsal should be yellow and large

#4 Body size and shape, caudal size and color, dorsal color

#5 Large well-formed body with yellow color on it. A yellow tail with a superwide tail angle. A yellow dorsal that is as large as possible at breeding time (which is 2 months for this breeder).

TRAITS LOOKED FOR IN BREEDER MALES

	#1	#2	#3	#4	#5
Body size	x	x	x	x	x
Body shape	x	x	x	x	x
Body color	x		x		x
Caudal size	x	x	x	x	
Caudal shape	x	x	x		x
Caudal color	x	x	x	x	x
Dorsal size	x		x		x
Dorsal shape	x	x			
Dorsal color	x	x	x	x	x
Other		x*			

* Late development

When it comes to the male picked to carry forth the strain, these breeders are, of course, considering the entire overall fish with an emphasis on the body size and shape and on color of finnage as could be expected based on expressed goals. Caudal size and shape run a close second. It should be noted that caudal size would probably be a unanimous trait looked for were it not for breeder #5 who is forced to select his breeders before caudal size can be fully determined. In looking for males that develop later, #2 is undoubtedly hoping to get better size by increasing the growth period prior to maturity. This is a technique that has worked well for other strains and #2, whose strain produces the most uniformly, is in the best position to begin working on secondary traits.

BREEDING AGES, SIZES OF LITTERS, RATIO OF MALES TO FEMALES

Strain	Age Bred		Average litter size	Ratio males/females
	Males	Females		
#1	4 months	4 months	30-50	60/40
#2	4-5 mo.	3-4 mos.	40-50	50/50
#3	5-6 mo.	3-4 mon.	40-80	50/50
#4	5 months	4 months	40	60/40
#5	2 months*	2 months*	15	50/50

* as young as possible

The earlier development of yellow strains in general is reflected in the earlier ages that yellow males are bred as compared with slower-growing color strains reported on in previous sections. Since the yellow males mature earlier their full potential can be assessed earlier, making it possible to select the very best males at a younger age. Females are bred at about the same ages as for other color strains.

GENETIC TRAITS BELIEVED CARRIED BY THE DIFFERENT SEXES

	#1	#2	#3	#4	#5
Body size	F	F	F	?	?
Body shape	M	F	?	?	?
Dorsal Size	M	both	both	?	?
Dorsal shape	M	both	?	M	?
Dorsal color	M	M	?	F	?
Caudal size	F	both	M	M	?
Caudal width	F	both	both	?	?
Caudal color	M	M	both	F	?

While these are more or less just "educational guesses" there are interesting similarities. Body size is attributed to the female breeders, dorsal size and shape seems to be attributed either to the male or to both parents. Beyond these there doesn't seem to be any consistent pattern of inheritance - the other traits differ from strain to strain and even between experiences of different breeders working with what originally came from a common stock (#1, 2 & 4).

Any Particular Features That Seem Linked To This Strain?

#1 Thinness of tails, large dorsals

#2 Zebrinous markings on peduncle area. Dark markings on sides of the body (95%)

#3 Vivid color patterns on body, especially in peduncle area. Small size, wide caudals, high-colored dorsals

#4 Can't answer

#5 Small dorsals in high percentage of males

Hormones Tried

#3 I tried testosterone on the females to see if coloring them would help eliminate the red color that keeps popping up. **Dosage:** drop per gallon every other day

Results: It did bring out red in some of the tails but only after they had been treated so long that they were sterile. I looked for some key factor on those showing red that might allow me to identify those carrying red without treatment, but could not find any reliable factor(s). Abandoned the project.

#4 I tried testosterone on the males to see if I could intensify the colors. I used 4 drops per 5 gallons once a week. End result was that the fish died after one month.

I often use testosterone on the females (I never show these), using 4 drops per 5 gallons once a week starting about 3 months.

Results: Big, beautiful females with intensified color - no color on the body, but in the dorsal "WOW" Caudals grows very large and dorsal medium large. No deformities but most become sterile.

Any Special Environmental Or Dietary Requirements

ANY SPECIAL ENVIRONMENTAL OR DIETARY REQUIREMENTS

	Salt Used
#1 - More vegetable matter in the diet	None
#2 - None	None
#3 - Feeding carotene helps color.	None
#4 - None	1 tsp/5 gal.
#5 - None	None

Special Problems

#1 Thinner tails that are easily frayed.

#2 None

#3 Just the color impurity problems as reported on

#4 Just the regular problems

#5 Very small droppings and considerable time between droppings.

Comments By The Breeders

#3 These are exceptionally active and vigorous fish...a joy to watch... but the persistent appearance of red makes them very frustrating fish to work with. I have almost given them up more than once but the ones that do not show red are such high quality and so beautiful that I guess I will probably keep playing with this strain for evermore, trying to increase the numbers of the all yellow fish.

#4 Yellows are very sturdy and prolific especially with beef heart

#5 This is the most difficult strain, other than the snakeskin a bunch that I have ever worked I feel luck has played a great part so far, but skill is needed from here on.

****

BE SURE TO WATCH FOR SECTION 7 on this series, **"BREEDING THE MULTIS"** in the near future

WHY ACID WATER KILLS YOUR PLANTS

author unknown

from ILLIAS via RAGGED TALES, June, 1974

Man really knows but little about the inner working of photosynthesis or its rough materials, but the basic formulas are beginning to evolve

Chlorophyll, is the unbelievable complex admixture that signifies its presence by the green pigment in the leaves, and that actually triggers this basic makeup.

Pyrrole is a colorless liquid that is not soluble in water, but is soluble in alcohol and ether. It's also soluble, slowly, in a weak solution of acid, and this is a critical point. When the acid condition of the aquarium water exceeds the required minimum strength, it leaches out the pyrrole out of the leaves and brings it into solution in the water. And if the acid strength is sufficient to leach out the pyrrole faster than the plant can grow and manufacture more - then the chlorophyll begins to fade in the leaf, and turn brown, for the lack of the needed ingredient.

And this is the endless chain reaction. As the leaves of the plant lose their green coloring, so do they lose the ability to photosynthesize under the light. This in turn takes away the supply of plant sugars that makes the plants grow. And the plant withers and dies - literally starved to death.

This decaying process is speeded along somewhat by the yellowish color of the acid water, which partially screens out the red and orange rays of the color spectrum, slowing further the critical photosynthetical processes and further weakening the plant involved.

When fish or other acid creating agents are not already involved the pyrrole liquid that is leached out of the chlorophyll being weak based, tend to neutralize the acid condition of the water and thus helps other plants to grow.

It follows that if you have a tank to waste, an acid tank can be neutralized, simply by adding plants, and as soon as they fade in color, removing them and adding more. This is nature's way but it works, naturally.

The nature of different plants makes some much more effective than others. Nitella, Nitrella especially, has long been used successfully as a water purifier, and as an indicator of its purity. When Nitella flourishes and is bright green, the water is fine.

There are exceptions of course, but in general this is the growth pattern of plants. Plants that by nature grow more slowly, require less plant sugars, thus less photosynthetical action, thus less chlorophyll and can grow in a more acid water. Conversely, alkaline water is demanded by the plants that grow more rapidly to subsist. ###

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SECTION V - BREEDING THE REDS

Red Strains Represented

#1 Gorski Reds, Pure when acquired. Maintained pure. (Lee Paul)

#2 Clarence Baxter's Reds, obtained through George Busovicki. Maintained pure. (Ted Kusak)

#3 Original Hall Reds. Over 14 years the following strains have been incorporated into the original Linley Reds. Hall Albino, Ahlers Reds, Gorski Reds (both A & B lines). (Midge Hall)

#4 Gorski Reds/Haenni Reds cross. (Clyde Mars)

#5 Combination of two strains worked by Joe Maddox for 3 years before I obtained them. I have worked them for 2 years. (Ed Driscoll)

#6 Ahlers Reds crossed into Tom Simmons Reds then into Gorski Reds. I have worked with them for 8 years. (Lou Wasserman)

#7 Morgan original strain crossed to Gorski Reds three years ago to give the current strain. Harold Morgan

There seems to be a history of more outcrosses made by breeders of red strains than were made with the Blue and Green strains reported in former AGP sections. This is probably due to the fact that bright, pure color is more difficult to maintain with red strains. It is known that there are at least four genes involved in red coloration and the more of them that can be combined in one fish, the better the color will be. If any of these genes do not exist in a red strain or become lost through continual inbreeding, the only means of picking up that gene is through an outcross.

Features Of The Strains As Compared To Average

	#1	#2	#3	#4	#5	#6	#7
Size			larger				smaller*
Tail Width	wider	wider					narrower
Dorsal	bigger	bigger	bigger**		bigger		bigger
Rate of Growth		slower	slower	faster	slower		
Rate of Maturity		later	later	early	later		
Fertility	more	less		less			
Cannibalism	less						
Susceptibility to disease	less		less				
Deformities	less***	less		more		less****	
Weaker/Stronger	stronger		stronger	stronger			

*Sometimes

**Dorsals are huge

***I have never seen a crooked spine in this strain

****Almost no deformities

It seems that the most universal traits of red strains are that they are stronger fish with bigger than average dorsals. It is interesting to note that the Gorski strain is represented in 5 out of the 7 strains listed with #1 being a pure Gorski strain. Comparison of the features of the pure strain with the features reported for Gorski outcrosses shows that overall strength and dorsal size have been maintained while the wider tails and above average fertility have been lost, except in the case of the #6 cross. The influence of the strains

crossed into has brought the deformity rate up to average in most cases and even above average in #4 strain.

Since #2 and #5, which do not mention any relationship to the Gorski strain, also have larger-than-average dorsals, it can be assumed that larger dorsals are common to many different red strains.

The majority of the red strains reported here have (6 out of 7) either average or slower than average rates of growth and tend to later maturity. A slower growth rate and later maturity usually add up to increased body size, therefore it is interesting that only #3 reports above average size. #4, the only strain that reports a faster than normal rate of growth and earlier maturity, is also the only one to report above average deformities. Is it possible that there could be a connection???

Breeding True

Strains #1 and #2 were pure strains when acquired and have been kept as pure strains by inbreeding. Breeding results have remained very similar even though color impurities persist in both strains.

Strains 3, 4, 5 and 6 have all been outcrosses known to their breeders. Results seem to have remained fairly uniform over the years and all have varying degrees of impurities within the basic red color.

Strain #7 showed considerable differences after the initial outcross with caudal colors ranging in varying shades from red to orange, but after four years of line breeding and inbreeding since the cross, the breeder has managed to bring the strain to fairly uniform production.

Strain	Time Kept		% of desired color	% with impurities	% different color
#1	3 years	Very similar	50%	50%*	
#2	?	Very similar	100%		
#3	13 years	Fairly uniform	70%	30%**	
#4	?	Fairly uniform	40%	60%***	
#5	2 years	Fairly uniform	50%	50%****	
#6	8 years	Fairly uniform	80%	20%	
#7	4 years	Fairly uniform	60%	35%*****	5%

*White in dorsal, black spots in dorsal and cauda, which seem to blend with the red in older fish.

**Faded red and too much black both show up persistently.

***Biggest problem is a faded red color or whitish shading.

****Black in dorsal.

*****Black or dark blue specks.

******Traces of black in dorsal. White splotches in tail.

Looking at the above information it becomes obvious that even within pure red strains there is a consistently higher percentage of color impurity than showed up in the previous sections for blue and green strains. Therefore, it can be expected, if working with reds, that pure color will be harder to attain and less frequent. Careful culling and selection of breeders will be required to maintain or increase the percentage of fish of the desired red color. Even though #2 reports 100% of the desired color, it is more likely a difference in evaluation of "desired color". Since he goes on to say that faded red color and too much black persistently show up, it is probably that these impurities show up in the "desired" red tail with about the same frequency as reported by the others.)

Since the red strains reported here represent some of the finest red strains in the country and have consistently, over the years, remained at the top in the highly competitive International show circuits, it

can safely be deduced that no one acquiring a red strain should expect to get more than about 60% so·d. brightly colored red fish ,and often less. ,as this seems to be the most even the top breeders expect from their top strains

How To Handle Impurities

#1 To avoid impurities I breed only those fema·es show·ng less b·ack

#2 No comments

#3 Selective breeding is gradua·ly work·ng impurities out

#4 Selective breeding is required to keep ,mpurities down.

#5 Pick·ng females with as c·ear color in the caudal as possible helps to fight color ,mpurity.

#6 No comment

#7 I try to breed around impurities by pick·ng females with clear caudals.

Environmental Factors Affecting Red Coloration

#3 - Salt, espec·ally mar·ne salt which includes higher quant·t·es of trace elements, increases red col·or·ation significantly. This has been documented ·hrough a series of controlled research experiments. The effects are long last·ng and to some degree permanen·.

Foods: various foods also affect red co·ors. W·thout baby brine shrimp in the diet, I find ·he red color fades. When flake yeast, beet juice or paprika are added to dry food the red color is intens·fied, but fades ·n 1 or 2 days if feeding is discon·nued.

#5 - Fresh water change seems to temporarily bring out black

The other breeders ·st no specific factors affecting red color of their strains, but the majority DO say they use salt with reds.

#1 - 1 Tbsp. salt per 5 ga·

#3 - 1 Tbsp. salt per 5 ga·

#5 - 1 Tbsp. salt per 15 ga·

#6 - 1 ·sp. salt per ga·lon

W·hile none ,st water chemistry other than salt as a factor, Dr. Lar·e's studies have shown that red color is affected by pH. " A pH in the ac·d range produces bright red. Neu·ral to sl·g·tly acid produces best color. An alka·ine pH produces more of a burnt orange color than a red. Boron (a poison so be careful) is very necessary for reds and oranges." He also found that "Vigaro" African Violet Food, used at half strength from what the ·abel directions spec·fy, does a good ,ob of supp·y·ng the elements needed by the fish for good color.

Type Of Breeding Which Best Maintains Or Improves Color

	#1	#2	#3	#4	#5	#6	#7
INBREEDING	x		x	x	x	x	x
Sibling cross	x		x		x*	x	x
father to daughter	x						
mother to son				x			
LINE BREEDING			x			x	x
# of lines kept			3			3	3
Crossed after how many generations?			4-5			4	6-8
CONTROLLED HYBRIDS					x**		
Cross of 2 unrelated pure strains					yes		
Always the same 2 strains?					no		
What colors?					red		
CROSS TO DIFFERENT BODY COLOR		x	x			x	
What diff. body color?		gold	gold ***			gold	
From related strain?		no	no				

*Best breeding to maintain color

**Best breeding to improve color

***Red color ,mproves but body, dorsal and caudal size suffer ·n all the red/gold crosses I have tried.

To main·a·n or ·mprove color six out of seven of these breeders work ·hrough ·he strain ·tself by using ·nbreeding and/or line breeding techniques. In addi·ion Breeders 2, 3 and 6 outcross to gold-bodied fish. Since gold bodied fish carry far less melan·n (black pigmentation) th·s method ·s often used ·n an attempt to clear up black spots or b·ack sh·overlays that so often occur in red strains. It should be noted that all the breeders making ·his type of outcross have outcrossed to golds. On the surface ·t would seem that the use of albinos, which carry no black pigmentation at a·l, would be an even better bet. However, ·his has not proven to be the case. Outcrosses to albinos have usually resulted ·n an increase in b·ack p·gmentation ·n the resu·ting hybrids. Th·s is logical. The albino gene blocks out al· visible evidence of any black col·oration the fish may have inherited, so although the finnage may look so·id red, there is more often than not much black genetica·ly presen· that is unable to show up in the albino but shows up in all ·ts glory in all grey-bodied hybrids the albino produces. Outcross·ng to an albino is rather ·ike try·ng to pick a white sock out of a drawer fu· of black socks in total darkness. Golds, on the other hand, are capable of showing some degree of black pigmentation, therefore the breeder can visually select those that wi·l pass the least black on·o their hybrid young.

Breeder #5 uses contro·led hybridization to produce better color. He continual·y outcrosses between red f·sh of unrelated stra·ns. S·nce he does not always use ·he same unrelated strain in h·s outcrosses, he either must have been ·ucky enough to locate more than one red strain that is compatible w·th his own red strain, or he is outcrossing mai·ly to pick up additional genes for red coloration and relying on the quality of his own strain to remove, in future generations, any undesirable characteristics the outcross might have ·ntroduced, or to recapture any des·rable characteri·S·I·C·S lost through ·he outcross. ,or perhaps he is using the hybrids only for showing and not ·ncorporating them into his own red ·ines.

Methods Of Breeding To Maintain Over-All Quality Of The Strain

Breeders 3, 4, 5, 6 and **7** use line breeding to maintain and improve the quality of their strains. This involves keeping two or more lines of the strain which are bred brother to sister. After from 4 to 8 generations, crosses are made between the lines. This process goes on indefinitely.

Breeder #5 also uses outcrosses to females of another fixed strain of reds. Since he continues to use the same "secondary" strain for these outcrosses, the two strains become more closely related each time the cross is made.

Breeders 1 and **2** carry their strains forward by using inbreeding only - either continuous sibling matings or father/daughter matings.

Methods Of Breeding To Produce Show Fish

Breeders 1, 3, 4, 6 and **7** do not make any changes in their breeding procedure to produce show fish. The fish they show come from their regular line-breedings or inbreedings.

Breeder #2 outcrosses his reds to an unrelated gold-bodied red line to produce the fish he uses for show.

Breeder #5 also outcrosses to other fixed red strains to produce his show fish. He reports, "to get increased body and caudal size, I out-cross males from the primary strain to females from the secondary strain. The resultant fry turn out to be larger-bodied than either strain with a slight compromise in color (slightly black-speckled caudals on many of the males). Caudal and dorsal size are increased over the main strain. The overall fish is better looking than either of the parent strains despite the small amount of black in the caudal. Recently I have been getting a small percentage of female-line males from the hybrids. Also the flair of the caudals is gradually increasing in the hybrids."

Results Of Outcrossing Red Strains To Different Colors

OUTCROSS		RESULTS
SNAKESKIN:	#1	Large bodied, well-marked red snakeskin.
	#3	Total flop. All tails grew unevenly.
	#6	Large-bodied snakeskins with short tails.
RED BICOLOR:	#3	The bicolor pattern was lost in the F-1. All came out solid red. Did not pursue further as the hybrids were not outstanding.
GOLD:	#2	I produce my show fish with such crosses.
	#6	Improves color in the reds.
	#3	Cleaned up the black saddle on the peduncle of the reds but body and caudal size suffer.
HALF BLACK RED:	#3	High quality half black red fry with solid red caudals and dorsals.
	#6	Good to excellent.
BLUE:	#3	F-1 were all high quality multis in combinations of blue, red and white. F-2 were 25% solid blue, 25% solid red, 50% multis as described.
	#4	Mixed multis.
GREEN:	#5	Fry predominantly red in caudal.
ALBINO:	#3	Improved the albino quality, but the reds picked up a smoky haze over the red caudal color. Using a different strain of albino produced mostly red bicolors.
YELLOW:	#3	Fair. Bodies smaller, caudals various combinations of red bicolor and red/yellow/white/black multis. Most dorsals considerably lighter than caudals.
	#4	Junk.
DIFFERENT RED STRAIN:	#4	Fair. High percentage of red bicolors.

As can be seen, the results of outcrosses of these red strains are variable with Half Black Red crosses appearing to be the best bets. Although the number of outcrosses to blues is far too small to allow for any concrete deductions, still the fact that good multis were produced from both reported outcrosses can give us some ideas.

1. A red/blue cross might be a good thing to try if you are after show quality multis (although the breeders of blues did not report too favorably on this in section I).

2. At least in these two instances neither blue nor red were dominant or recessive to each other, but seem to be equally dominant. The neat Mendelian breakdown of the F-2 reported by #3 lends additional support to this idea.

If All Of The Strain Were Lost Except One Lone Male...What Would Each Breeder Consider To Be The Best Outcross To Preserve The Color?

#1 A red with a gene for large dorsals and large caudal sex-linked on the X chromosome. I would expect the F-1 to look like the father.

#2 Red. I would expect more red deltas.

#3 Red or gold to preserve solid red color and dorsal size. I would expect all F-1 to have good red color.

#4 Red. I would expect 0-20% good red, 80% red bicolor.

#5 Wide caudaled red with red color in caudal and dorsal, because the solid red-tailed females help maintain color, which seems the hardest. Would expect good red color in caudal and dorsal, average % of deltas, average body size.

#6 Red.

#7 Blue. I think I would have less impurities to clean up. Would expect red bicolor in F-1.

The most popular choice obviously is to use another good red strain female as an outcross to preserve the color of a red strain. #7's choice of a blue is rather startling, but his reasons make sense, particularly if a good, clean red strain cannot be found. If this outcross were to work like the red/blue outcross reported by breeder #3, he would be back to solid reds in the F-2.

Breeding Goals

#1 To improve the color and breed out undesirable body shapes such as big shoulders and droop snout. I would also like to make both the body and dorsal larger and put on a caudal of at least 90 degrees.

#2 A general overall good red color without sacrificing dorsal and caudal shape or size.

#3 Good consistent show-quality reds with bright red color, good pure stock through which to work albinos, snakeskins, golds, etc.

#4 Pure color and large size.

#5 Pure bright red caudals and dorsals, a high percentage of deltas with good body size.

#6 More red and brighter red color.

#7 Widen the caudal, while maintaining color.

The goals of the breeder more or less dictate the qualities he will look for when selecting breeding stock. With the red strains there is a unanimous emphasis on improving color, which seems to be the weakest point of most red strains, while maintaining size and finnage. Now, let's take a look at the breeding methods each is using to reach this universal goal.

Selecting Female Breeders

#1 Females at least 2" long, deep through the chest and well-rounded. The caudal should be large and I look for a light pink color with as little black as possible. The C/R ratio should be 2 1/2 to 1 or less. The dorsal should be large, elongated and show some color. The female must show a large gravid spot. I consider the female to be the most important fish in breeding.

#2 Females with large bodies and round caudals.

#3 Females with a short, stubby body. The caudal should leave the peduncle at a wide angle and be as large as possible. Color should be as solid as possible. Lavender/blue toned females seem to produce the best red caudals in the males. If the female caudal is red, it is especially important that the red appear in the bottom 1/4 of the female's tail. For some reason I find that females with clean bottom quarters throw males with more black in the tail. The female's peduncle should be as wide and short as possible. The dorsal should be elongated.

#4 Females with large size, short wide peduncles, good body shape and good dorsal shape.

#5 Females as large as possible and deep through the abdominal area. The C/R ratio doesn't seem too important as long as she is not exceptionally deep through the peduncle area. I look for red color in the peduncle area and a solid red caudal that is either shark-tail or wide-round in shape. The dorsal should be as long as possible with good red color.

#6 I pick out my females too young to tell, much except their sex.

#7 I select females mainly by caudal shape, caudal color (light blue/lavender) and C/R ratio.

Traits Looked For In Female Breeders

	#1	#2	#3	#4	#5	#6	#7
Caudal/Ratio*	X		X	X			X
Body Size	X	X		X	X		
Body Shape	X		X	X	X		
Body Color					X		
Caudal Shape	X	X	X		X		X
Caudal Color	X		X		X		X
Caudal Size	X		X				
Dorsal Shape	X		X	X	X		
Other	X						

*The Caudal/Ratio is a comparison of length to width of the peduncle area.

Although the goals toward which these breeders are working are virtually the same, they vary somewhat on how they select female breeders for these red strains. 5 out of 7 use caudal shape as one determining factor. The majority (4 out of 7) also select female breeders by C/R ratio, body size, body shape, caudal size and an elongated dorsal.

Selecting Male Breeders

#1 I look for a large well-rounded body with a strong peduncle. I want the body an intense red. The caudal should be red with as little black as possible. The wider the spread, the better, and upwards of 1 1/2" in length. The dorsal should be elongated and a good clean red color.

#2 I select mostly for color, of body, caudal and dorsal.

#3 I look for males with large stubby bodies with a maximum of red and the least black saddle on the peduncle. The caudal should be solid red, delta shaped or better, and should be at least as long as the body. The dorsal should be large and solid red.

#4 I look for body size and shape, caudal size, shape and color, and good dorsal shape and color.

#5 The male's body should be as large as possible with a maximum of red coloration. The caudal must be delta and the purest bright red I can find. The dorsal should meet IFGA standards and be red. I look for as small a black bar on the peduncle area as possible.

#6 I select male breeders first by size, second by caudal shape, then by caudal color, dorsal color, body shape and dorsal shape, in that order.

#7 I look for size, color of caudal, dorsal and body, and the shape of the caudal.

Since all breeders had responded improving the color as one of their goals it is not surprising that all seven of them consider caudal and dorsal color as one of the major criteria when selecting male breeders. with #2 listing ONLY color as his major deciding factors in choosing breeders for his red strain. Next in importance seems to be body size and caudal shape (6 out of 7). Then body color and dorsal shape (5 out of 7) with the rest of the characteristics assuming less general importance. Most breeders do indicate that they take a careful look at the overall fish in addition to the main features they are seeking.

Breeding Ages, Size Of Average Litters' Ratio Of Males To Females

	Age Bred		Average	Ratio
	males	females	litter size	males, females
#1	5 mo.*	5 mo.	40-50	1/1
#2	5 mo.	5 mo.	30	4/3
#3	6 mo.	3-4 mo.	40-90	1/1
#4	6 mo.	6 mo.	40-50	1/1
#5	6-7 mo.	3 mo.	50	1/2
#6	4 mo.	8 weeks	45	1/1
#7	5-6 mo.	3 mo.	40-50**	3/2

*Nothing younger. Some of my males have to mature old.

**Second dropping.

It is obvious that all of these breeders are waiting until their red males have matured so they can take a good look at how they develop before selecting their breeders for the next generation. Most seem to breed their females at a much younger age than the males, indicating that they either raise several successive droppings of full siblings or are using the next generation of females to breed with the older males.

Genetic Traits Believed Carried By The Different Sexes

	#1	#2	#3	#4	#5	#6	#7
Body size	F			*	both	?	M
Body shape	F			*	both	?	M
Dorsal size	F		F	*	both	?	M
Dorsal shape	F			*	both	?	M
Dorsal color	both			*	both	?	M
Caudal size	F	M		*	both	?	M
Caudal width	F	M	F	*	both	?	both
Caudal color	both		both	*	both	?	both

*Doesn't seem consistent

Remember when looking at this chart that, the answers are mostly just educated guesses based on experience gained by working with these particular strains. They should not be taken as cold, hard facts as few, if any, of these breeders have attempted the research necessary to prove these guesses. The only things that show much agreement at all are that the female carries dorsal size and both male and female share in passing along caudal color...and that the guppy is a highly complicated and variable fish.

Do Any Particular Features Seem To Be Linked To This Strain?

#1 Large body, large caudal, extra large dorsal. All of my siblings produce these features

#2 90% or better are delta-tail

#3 Extra large dorsals on both males and females

#4 (none listed)

#5 All are 'late bloomers'. They take about 7 months to show potential

#6 Very large caudals.

#7 (none listed)

Special Environments

#3 Tails do not hold up well if water is not kept very clean. None of the other breeders listed any special environments.

Special Problems

#1 Some of the mature fish have a droop snout and bad shoulders. Some of the mature fish have a concave posterior edge of the caudal

#2 None listed.

#3 Some develop uneven fin growth.

#4 None listed.

#5 When the main strain is continually inbred, color is maintained, but size begins to decrease. I can get virtually all the black or dark coloration out of the caudal but body size suffers as a result.

#6 None listed.

#7 None listed

Use Of Hormones

#2 I have tried hormones with this strain occasionally. The results, slightly larger fish of about the same color. I evaluate the results as good enough to use if show fish are desirable

#3 I have experimented with hormones on both males and females. The results have not been spectacular except in the case of increasing female fertility by treating them with female hormones - this has proved to be invaluable

Hormones Tried On Red Males

Type	Age Begun	Dosage	Results			
			size	color	deformities	fertile
#1-Theelin	3 wks.	1 cc/10 gal. weekly for 5 weeks	slightly larger	same	No	all
#3-Estarone	2 wks.	1/10 cc per gallon, weekly for 4 wks.	slightly larger	same	No	all*
#4-Strebostrol	4 wks.	10 cc., for 4 treatments	about same	less	A few	some sterile

* I didn't test each for fertility but had no trouble getting fry from any male I used. Tails did not grow out as fast as usual so I tried 1 drop of testosterone per gallon from 4 to 5 months to try to push the tails out. Didn't seem to do much. Fish never did turn out to usual caudal size

Hormones Tried On Females Of Red Strains

Type	Age Begun	Dosage	Results
#3 Estrone	2 wks.	1/0 cc per gal. weekly for 4 wks.	No visible changes but fertility increased. 1st litter at younger age. Larger litters.
#5 Dimabol	3-6 mo.	varied	Increased caudal and dorsal color and size. Some color in peduncle. No sterility (maybe not in it long enough). Much color remains after removal. Pregnant females treated dropped fry already showing their colors and with miniature gonopodiums. Excellent way to color test fry female will drop.*
#4 Strostrol	4 wks.	10 cc., 4 treatments	No visual changes but some proved to be sterile. (These females happened to be in with the males that I treated.

* Fry dropped by females during treatment were removed to untreated water where they grew normally and completed maturation about at the same age as normal fry. Even though they had started with a miniature gonopodium, it did not develop any further until the normal time after males removed to untreated water. All of the males were fertile and sired normal fry. I did not keep the female fry so do not know if they were fertile or not.

Comments By Breeders

#1 The female seems to be the most important fish in breeding. I think this study is a very good idea and I will help whenever I can

#5 I inbreed and outbreed two separate strains of reds. The main strain is the one I have had the longest and is the one I have reported on. With the main strain I pick breeders as reported and they throw fry with a high percentage of clear red caudals and dorsals in both males and females...about 50% dorsals with average body size. As I have stated, the clear red color is the hardest single factor to maintain, so I follow the above. To increase body and caudal size I outcross to the secondary strain (male from main strain to female from the secondary strain). I select breeders the same way except that I pick a female with a salmon-colored caudal and as few black specks as possible. The results are fish larger than either strain but with slightly speckled caudals

No additional comments were made by the other breeders

HELPFUL HINTS

by Peter Tedesco

As you know after your racks are built, they should be painted with redwood stain and then varnished. This helps preserve the wood from rotting. If nuts and bolts are used to hold the racks together, put a little more varnish on these. It helps to keep them from rusting.

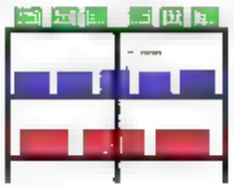
If painting is involved do it right the first time and you will not need to do it again. You will not be able to paint, once you put your fish in - the fumes will coat the waters surface and suffocate the fish.

Painting your floor if it is concrete, has its good and bad points. Water passes freely on a rough concrete floor. If the floor is painted, the floor then becomes sealed and the water cannot pass through the porous concrete. You will have to give it at least two coats of water proof enamel paint to do it right. This would not harm the fish if you have proper ventilation until the floor dries. Now you have a nice smooth surface and it is very easy to clean and mop.

It also helps keep down the dampness and keeps the cold from seeping through the concrete. It will make the floor insulated against the cold from coming up from the ground in the winter.

Now when you insulate the ceiling - after you install the insulation between the ceiling beams, cover it with a heavy duty plastic. That is all you will need. Do not keep the heater on too high, just enough to keep the tanks at 74-76 degrees. All you have to worry about are the tanks on the floor as you know heat rises.

A lot of heat is not good. Think first.



RECORD KEEPING

By Tom Allen

Record keeping, unlike the weather is something we not only can talk about but are in a position to do something with. Why is it then that novice breeders stare quizically when "keeping tabs" is mentioned? Why do many advanced breeders, on the other hand, tend to overlook it using the excuse that they have gotten along "OK" up to now without having to keep any records? This attitude is difficult to understand though of the wealth of genetic knowledge that is obtainable with the simplest record keeping system.

Keeping accurate records is a must if you intend to continue an effective breeding program for any length of time. All of us are aware that the largest fish, those "Best of Show" fish we so often wish were our own, are most times hybrids provided by an outcross of two strains. Imagine the anger and embarrassment of the breeder if he/she "forgot" which combination of strains were used and could not reproduce this cross.

As proof of the need for keeping records, let me cite the following example. Suppose you possessed three unrelated strains represented by RR (for reds), BB (for Blues) and MM (for Multi). There are nine possible first-time crosses that you could make.

1 - 3) RR, BB and MM - keeping each strain pure by inbreeding brother to sister, son to mother, etc.
4 - 5 RB, RM - outcrossing male of strain RR into females from strains BB and MM
6 - 7 BR, BM - Outcrossing male of strains BB into females from strains RR and MM
8 - 9 MR, MB - Outcrossing male of strains MY into females from strains RR and BB

Note also that nowhere in 1-3 above is there any mention made of inbreeding (breeding separate brood one of the same strain and back crossing after 3-4 generations) which would certainly increase the number of possible combinations. Maintaining only two lines of each pure strain would bring the number of combinations up to 12. This number of strains (and the associated number of tanks required to breed them) is not recommended for anyone but the most advanced breeders.

The medium on which your records are kept is not important although some thought should be given to selecting something that can be corrected with a minimum of effort should an error be made. A 3 x 5" index card is handy in that it is not bulky and can be corrected (or destroyed) with ease.

Each new strain or each new cropping of young should have a record containing information such as:

A) A sequential file number or unique to each record (first entry receives number 01., second 02, etc.)
B) The name of the breeder (or other source) from whom the strain was obtained
C) Any known genetic data
D) File numbers of the parent fish
E) Any visually identifiable strain traits such as poor dorsal size or color, ragged caudals, etc.
F) Names of other breeders working with the same strain
G) Date of birth
H) Strain code (BL1=blue strain from breeder X, BL 2 = Blue strain from breeder y, etc.
I) Generation code (F1, F2, etc.)
J) Any known compatibility with other existing strains.

See example 1 of an index card showing this type of information.

Example #1

43	Gommel Reds	RE 3
A (File No.	B (Strain Designation)	H (Strain Code)
F2	4-1-73 RE3 x RE3 (Parent Strain)	
I (Gen. Code)	G (Birth Date) 37♂ 37♀ (Parents File Nos.	
	E Mis-Matched Dorsals	
	J Not compatible with RE2 strain	

In relating the actual fish to their record, it becomes a simple task to copy the strain code, file number and date of birth onto a self-stick label and affix this to the tank. Don't forget to move the label each time you move the fish to new quarters.

An example of a typical label follows.

RE3 - f3
4-1-74

If you have not begun to keep records on your breeding program, the time to start is now. You'd be surprised at how little time it takes - certainly a small price to pay if it improves the quality of your fish.

See you in the "winners circle" soon.

A SIMPLIFIED CODING FOR BREEDING RECORDS

by Midge Hirt

A frantic plea from across the sea again emphasized how complicated the identification of various matings of guppys can get if you are one who likes to keep records of all your inbreedings, outcrossings, etc., and how what seems to start out as a simple system can challenge a computer by the time the third dropping from the 7th generation from an outcross is outcrossed with say the 5th dropping from the 3rd generation of another line.

Henry Vidal of the English Fancy Guppy Association hollered "help" when his system of record keeping reached the point where his crosses began to look like some of Einstein's formulas. As he pitifully asks, "What do you call the fry from a cross of 7(2 FDA x FB5(3)? Please, can someone, somewhere give me a foolproof system of coding that does not involve what appears to be a mathematicians nightmare?

After wrestling with several coding systems, most of which sooner Or later got me into the same trap as Henry's got him, I finally came up with what has proven for me to be a simple, foolproof system of identification. I have now used this system for approximately 5 years without running into trouble (longer by far that any other system I tried). Maybe it can help others of you who like myself, are interested in keeping track of just where your current guppy stock came from and how it has developed. For example, I can take any litter of fish now swimming in my fish room and quickly trace their history back through all inbreeding and outcrosses in their entire background. (This sometimes turns up interesting facts!) And the best part is that there is very little paper work involved.

The key to the whole thing is that, instead of giving breedings an ever increasing array of letters and numbers to indicate backgrounds, each litter of fish is merely given a single number. Starting way back when with number one, each litter or individual fish I wanted to identify was given the next consecutive number on the listing no matter from what strain or cross it came.

The basic record book is very simple and involves very little time or calculation. After 5 years of using this system I am only on page 13 of the book yet have full details on 35+ breedings. The Breeding Log is set up as follows:

BREEDING LOG

ID #	Fry or Breeder	Color Strain or cross	Gen.	Type of Cross	Parentage or source	Date of birth or equiv.	Litters produced	Breeders produced
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

THE WAY THE BREEDING LOG WORKS IS:

(1) The next consecutive ID# is given to each litter when it is born, no matter from what strain. All fish in that litter are identified by that same simple number. The only time a fish from that litter would be assigned a new number is if it turns out to be so outstanding in some way or

BREEDING LOG

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(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)

other that it is desirable to be able to trace all future generations bred from that particular fish in which case it is assigned a number of its own. Incidentally, each and every new litter gets its own ID# even if it is the 3rd or 4th dropping from the same two parents. New fish that are acquired for breeding purposes are given identification #s at the time their first offspring are born (why give it space in the log if it is going to prove sterile or unbreedable?

(2) Since most numbers are assigned to litters of fry "fry" is usually what is written in this space. However, when unusual fish are assigned their own numbers the word "breeder" is entered here to indicate that the ID# stands for just one special fish rather than a litter of fish.

(3) Here is written a description of the strain or cross involved, such as pure Red, Red. or Singapore snakeskin x Red Yellow. This identifies the fish only as to immediate parentage or background. Any complicating factors in the background are traceable back through the columns (6).

(4) This indicates the generation represented by the fish assigned that particular ID#. Maybe it is the F-7 (seventh generation) of inbreeding of a pure strain, or perhaps the F-1 from a new outcross.

(5) The type of breeding is recorded here. SIB = brother x sister. BC = back cross of fry back to the mother or father. LC = line cross between 2 lines of the same strain. OC = outcross, etc. Incidentally, any time any breeding other than a S. B breeding is made, the correct procedure is to return to the F-1 in the previous column as only brother/sister matings produce the next true generation.

(6) For the parentage or source all that needs to be written are the ID#s of both parents. For example: Male #159 x Female #170. The background of the parents can be easily traced by looking up their ID#s elsewhere in the log, and the grandparents, the great grandparents, etc. on up the lineage. If the ID# represents a new fish which you have acquired and used for breeding a note is made here as to its source. Working from this column upward it is possible to trace all ancestors in the background of any given fish or litter of fish.

(7) This is self-explanatory.

(8) This column makes it possible to trace the patterns of heredity the other way downward to all subsequent generations bred from a given fish bearing this particular ID#. If, for example, a male from ID# 159 is bred to a female from ID#170 and the resultant fry are identified by ID#215, the #215 litter is recorded in the "litters produced" column of both the #159 and #170 IDs.

9 When specific outstanding fish from a litter are deemed worthy of being given their own ID# that fact is shown in this column so that the downward inheritance can be traced in a continuous line from any fish near the beginning of the log to any and all fish descending from it.

Although this system gives a clear, concise picture of the breeding behind any strain of fish, a few more details are needed to make the material really meaningful. I keep a 3x5 card with each litter or breeder giving the ID# of the fish. On this I jot notes as to whatever seems to be important,...such as how many deformed fish might have showed up in a litter, percent with color impurities, size range of the males, any outstanding show fish in the litter, any unusual raising techniques that could have affected the Outcome of the litter, any genetic information such as the presence of albino or gold recessives, the general quality of the litter, etc., etc. After the fish bearing the ID# on the card are no longer around, the cards are filed in numerical order for future reference.

Not only does this whole system help to explain any oddballs that might show up, but it is invaluable in cases where a strain has gradually deteriorated or has greatly improved. Without some system of tracing the background you probably would never know why either of these things happened. In the case of deterioration the records can point to things that should be avoided in the future breeding of the strain, in the case of improvement it is most certainly an advantage to know what you are doing right so it can be done over and over again.

You may think you can remember all these details and maybe YOU can, but I have proved to myself at least, that important facts get forgotten. And I have one card to quote as an example. On this card I had noted in capitalized letters "SPECTACULAR FISH". I'm sure at the time I couldn't imagine ever forgetting such splendor but on running across that comment a few years later, no amount of brain racking could bring back just what was so spectacular about those particular fish and so a valuable fact was gone forever.

Of course, the more you say in your notes, the more it will mean in the future, but the beauty of this simple system is that it enables you to keep meaningful breeding records of proliferating guppys without getting also involved with proliferating code systems.

LARGER TAILED FEMALE GUPPIES!

by John C. Mortenson

More and more attention is being paid to color and fin development in female guppies, and rightly so, since for many years she was the drab counterpart of the already highly developed male. Nowadays most of the large guppy shows have classes for females. I, for one, am happy to see this, for I feel that when really pretty female guppies become common, interest in guppies will become even more widespread than it is at present. (who knows, even a few ardent killifish admirers might keep a couple of tanks of guppies, though it be at the awesome risk of being kicked out of the killifish clubs.

In my case, I have been busy for the last year and a half trying to transfer the red tail of the female flamingo guppy to my own golden strain females and to half-black females. Incidentally, I have found, as have no doubt a number of others, that this is more readily done by crossing a flamingo female with a male of the other type rather than vice-versa.

Another project I started about the same time was an attempt to produce a bigger tailed half-black guppy as many of you also have been doing. Late in November, 1962 I placed a small-boated delta-tail half-black male with a virgin female from a good green strain. On Christmas day about 80 young were born which were to be the most exciting guppies I had ever raised (and I have been raising veil tails for about 2 years, spending approximately 7 years developing a good gold strain).

As soon as possible I separated the sexes of these young hybrid guppies and they seemed to be developing normally until summertime. Upon returning from vacation in July I noticed that practically all the females were showing a slightly thickened anal fin, also much larger than normal tails. Frankly, I was disappointed. I knew from biology courses that female animals normally have a certain amount of male hormone and vice-versa and it now looked like these females had an excess of the male hormone for some reason at which I could only guess. I assumed that these females would become "males" as sometimes happens in certain strains and would thus be unfertile.

As the days went by, I became more certain that this was the case and was about to throw them out when, lo and behold in August, we received a telephone call from a friend in the Milwaukee Aquarium Society who stated, before hanging up, "By the way, that pair of guppies you gave me had babies." "That pair" she was referring to was a brother and sister from this brood.

I shocked explain that in this one brood there were about 40 females and the same number of normal looking males. All but two or three of the females had the half-black pattern and only a couple of the females had small tails. Only two of the males had the half-black body (they both had reddish-brown tails and only one of the two had a good wide straight tail). The rest of the males had good black tails with the black running up into the body no more than 1/4 inch. Three of the largest-tailed females had attractive black and white patterns with a fringe of brown and the rest had black and white splotched or most black tails.

So in the middle of August I selected five of the best males and placed three or four sisters with each one, naturally these females were the ones with the largest and best-shaped tails. Most of these females had offspring, the first ones being born on September 11 to the female pictured with this article. This female had been mated with the good, reddish-tailed, half black male. She had only 14 babies and didn't get much excitement, but on October 9 she had about 60 more, much to my relief (I was afraid she had dropsy). (Editor's Note: We don't have the picture.)

I soon had so many babies I didn't know what to do with them so I only saved the ones which were fathered by the good reddish-tailed male with the half-black pattern.

The big question now was, would this trait for big tails in the females be carried as a transmissible genetic factor and, if so, would it be carried by both parents or only one, and if so, by which? Those who know me well, know that I am more skeptical than most people and I resolved not to get too excited until I found out whether the trait would be inherited by the daughters. To shorten the story, I can happily announce that most of the daughters are definitely showing the large tails though only 25% of them have the half-black pattern whereas all the young males now show it. So now I am starting to breed these daughters with their brothers, which will make the old female shown in the photograph (now about 18 months) a grandmother shortly. The genetic questions remain as yet unanswered - what is the mode of inheritance involved here - can this trait be transferred to other strains of guppies? I am tempted to think that it can - certainly hope so.

This is a reprint article from GUPPY NEWS of July 1964.

Must as we love you, Midge Hill's editorial comment too.

IFGA Editor's Note: Although this article was written 11 years ago and large-tailed females are quite common now, it is interesting to note how it all started, at least for one breeder, and how he went about developing the new feature that showed up in his tanks. The genetic questions raised are still more or less up in the air, but there is considerable agreement that in strains being bred for the beautiful, large-tailed females, the males of the strain tend to be only average in quality.

WHO SAID YOU CAN'T BE GUPPY BREEDER ???

By Tom Anola

(Editor's Note: This reprint article was submitted by our new librarian, Tom Robertson, as something of value to the breeder operating on a small scale. I'm glad he did as he represents a "silent majority" - where did I hear that?) that is often overlooked. Frankly, I do not think this article offers the best advice for an experienced breeder, as I will explain, but for the novice it offers excellent rules on how to stay out of trouble caused by inexperience and just plain bad luck. The Brooklyn Aquarium Society Editor noted that this was Tony's own opinion and asked for comments. My comments will follow.

Who said that you have to have a lot of tanks to become a quality guppy breeder? Well, just about every well known guppy breeder will say so. The theory is you need from 25 to 50 tanks to produce good quality guppies. I feel this is all a myth, a lot of unproven facts. I feel that actually a person can breed guppies with only 6 or 8 tanks.

From my past experience it was common knowledge that a guppy breeder was rated by the amount of tanks that they maintained. If a breeder ran 10 tanks or less, they were considered a novice. If they ran 25 to 50 tanks they were considered a professional. If a person was lucky to have and maintain 75 to 100 tanks then they were considered some kind of expert. They were out of the ordinary, with plenty going for them.

I feel that the number of tanks that a person is able to maintain should not classify the individual as the type of breeder they really are. I say let a person be classified with what they do with the amount of tanks that they have! Do they produce good quality guppies? or are they just hobbyists, with average guppies, that should be the real Question.

(Editor's Note: I certainly hope that nobody thinks that a person is an expert if he keeps his tanks full of guppies. Even keeping them full of quality guppies from recently purchased stock does not signify an expert. I would classify an expert as one who maintains and improves a strain for a sustained period

of time. Although plain bad luck plays a role, the experts are the ones that consistently win through their own efforts

I have known a few of these so-called big time guppy breeders with an amount of tanks that would make any serious guppy breeder envious. Actually, what these big guppy breeders produced with all of their tanks would not make you very envious at all: you would feel disappointed. The point of all of this is to be thankful for what you have, and try to make the best of the situation. A little imagination goes a long way

To breed good quality show guppies there are always certain rules to follow which are very important. I will also introduce to you a breeding program that was told to me by one of the top guppy breeders of our time, Mr. Fred Samuelson

Different Rules to Follow:

Obtain and keep only the amount of tanks that you are able to handle. Do not bite off more than you can chew. Read and learn the fundamentals of good guppy care. Learn the basic genetics dealing with the strain you are working with. Obtain the best quality guppy strain that money can buy. If the breeder is honest, you should get what you pay for. Know where your guppy strain comes from: don't be afraid to ask questions of the breeder. The person you help may be yourself. There is plenty of work connected to guppy keeping. For example

FEEDING: I feed from 6 to 8 times a day including live food to be one of the foods.

Water Change: I siphon out 1/3 from the bottom of my tanks each day or every other day. This will help keep control of the bacteria and ammonia build-up that could be very harmful to your show guppies.

Changing Filters: I change filters each week. I change charcoal every month, charcoal is useless after only a few hours anyway. After putting in fresh charcoal it loses its potency to hold gases

TEMPERATURE: I prefer to keep my tanks at a constant 80 degrees; young and old alike

This is a breeding program that was told to me by Fred Samuelson, who was a past president of the Brooklyn Aquarium Society and at one time was a very active member. He was famous as a guppy breeder for many years. I will tell it the way it was told to me about seven years ago. I have used this program myself and found it to really work to my advantage. The reason for this is that, I am limited for tank space.

This method of breeding would be considered line breeding. I feel all of the desired traits can be maintained for years with this line breeding program.

The first step is to select the most desirable strain that you want to work with, keeping in mind to select for body size, color, and good fins. Anything else can be worked in to your program later on.

How to breed for quality once you have obtained an established strain!! Breeding, by the numbers:

1. Set up three different breeding tanks (bare bottom tanks would be preferable). 5-gallon capacity is ideal.

2. Purchase three females and one excellent male from one specific established strain. They should definitely be related to each other. They should also be young stock, between 3-1/2 and 4-1/2 months old. This makes working with them more flexible. (Editor's Note: Tony assumes brother and sisters will be used.)

3. Put one female in each of the different three tanks marking the tanks A, B and C. Also be sure that you obtain virgin females, otherwise the first babies should not be used in your breeding program. The second and third sets of fry could also be suspect.

4. Place the male with the first female in tank marked A. You will have to allow enough time for the male to perform his task as the basic breeder.

5. Repeat this procedure with the remaining two females in tanks B and C.

6. When F-1 young have been obtained from all three different females, they should be separated after 3 or 4 weeks old. Make sure to keep males and females separated for future selection in this program. The fact that all the females have been mated to the same male, and the three females are sisters makes all the F-1 young first cousins to each other. This relationship between all fish involved is close, but safe.

Editor's Note: The fry are cousins on the maternal side, but are actually half-brothers and half-sisters on the paternal side. At this point I count six tanks for the fry, and one to three tanks for the parents if they are to be saved. I would suggest that the male be saved since he may be better than any of his sons and the females should be saved since one may prove superior to her sisters.)

Keep in mind that keeping records is very important with any breeding program, but especially important with this program. The tanks that contain the F-1 young should be marked accordingly - A-1, B-1, C-1 and don't forget the date of birth.

7. The basic breeding of this program would be to select the best male from tank A-1 and cross him to a selected female from tank B-1. Selecting again the best male from tank B-1 and crossing back to a selected female from tank C-1. Completing the above method, select a male from C-1 and cross back to a good female from tank A-1. What you are doing is simply criss-crossing, back and forth first cousin to first cousin causing a close relationship but not too close to cause any real harm as could be caused by breeding brother to sister for long periods of time (*Ed: meaning for generations*)

Inbreeding brother to sister for any real length of time can eventually result in losing the strain completely. If you do not lose the strain completely then you are sure to cause other deformities. On the other hand this method of line breeding can maintain a guppy strain with all of its good qualities for many years.

Editor's Note: As I mentioned earlier, I feel that this is a program for an inexperienced breeder. The crisscrossing method keeps a larger pool of genes going so that the breeder does not have to be as careful in the selections. As with any gambling plan the better the odds, the slower the return. Many breeders would use the same number of tanks but would breed brother to sister in three separate lines and crisscross only every third or fifth generation. This offers the same type of protection and quicker results. If a large number of tanks are used, the breeder can try large numbers of pairings within the same line and again not have to be as expert in making the selections. I was going to comment on the remarks about inbreeding but decided I would put together a small article instead which follows this article.

In the time I have used this breeding program I have found it to work to my advantage. I am very limited in my tank space and for this reason I need a sure thing. I feel that this line breeding program is a sure thing. I am breeding for quality, not quantity, therefore time is no barrier.

Let me conclude by saying that inbreeding has certain advantages when trying to establish a guppy strain, there again, line breeding takes all the guess work out of knowing when to stop breeding so close.

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INBREEDING - FACT AND FICTION

By Jack Rosengarten, FPGA Active Member

Many things have been said about the evils of inbreeding but little seems to have been said about the true facts. Inbreeding can be either good or bad or both, depending on the talents of the breeder and a certain element of luck.

Simply defined, inbreeding is the mating of closely related individuals. This has the effect of allowing recessive characteristics which normally would stay hidden to be displayed. Closely related individuals can be expected to be carrying the same recessive genes and therefore some offspring will receive a pair of the genes which is what it takes to display a recessive characteristic.

Inbreeding or incest as it is called when applied to humans is frowned upon by society because of the well documented occurrences of hereditary diseases in such relationships. Horse, cattle, dog and cat breeders avoid inbreeding for the same reasons. Many fish breeders, as in the previous article, think the same way, but should they?

Inbreeding concentrates all of the recessive genes, the good and the bad. What then is different about the inbreeding of the higher animals and fish? In a word - **NUMBERS!** Horses and cattle usually have one baby at a time; if an undesirable result occurs, it is costly and time consuming. Dogs and cats also have small litters so that inbreeding is chancy. Fish, however, have large litters which yields a closer approximation of the hereditary ratios developed by Mendel. Inbreeding does not create deformities, it merely makes it more possible for them to be displayed. Likewise those longer fins, purer colors and greater size can also come to the fore instead of staying hidden. With large litters the breeder is not faced with a total loss if something goes wrong. In fact, he can expect something to go wrong, AND he can also expect something to go right. That is where culling is important. A good breeder will select the next pair to be bred very carefully. If he is lucky enough to have a lot of tanks, he should select a number of pairs so that all will not be lost if one wrong choice is made.

Many breeders will use schemes to provide insurance against running into a dead end. Either by using a crisscrossing method as in the previous article or in breeding separate lines of the same strain. Some will combine both methods by crossing the lines after some number of generations. For breeding show male guppies, I prefer line breeding with as many pairings as possible since the females can truly only be selected by trial and error or at best an educated guess. Records are important so that the breeder will know when something is going wrong. Ignoring the first indications of something going wrong, indiscriminate inbreeding, or population breeding where the true parents cannot be determined are the common pitfalls of a poor breeding program. Numerical counts of the good and bad results will let you know if the goals are being achieved. Merely culling every time a defect is spotted without recording the fact is living in a fool's paradise. This is the reason many breeders show spectacular results for a year or two and then lose the strain.

What should you do if a strain is deteriorating? Most breeders will dump them and buy some new stock (from someone who knows what they're doing) and start all over again. What a waste! Breed your strain to a closely related strain and with a carefully determined program breed out the undesirable traits and whatever effect the outcross caused. This will be much easier than starting all over. In summary, inbreeding requires precisely administered techniques in order to be of value.

You also will discover that inbreeding will turn up many new characteristics because the mutations and crossovers which frequently occur will now start to show up instead of being lost without ever having appeared.

SPECIAL REPORT

Section V... in the Advanced Guppyist Panel Series on the "Techniques of Breeding Specific Color Varieties"

ADVANCED GUPPYIST PANEL

Project I, Section VIII - Breeding the Snakeskin

ADVANCED GUPPYIST PANEL MEMBERS

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Hal Socha, California
Jim Thale, Missouri
Rich Trickel, Indiana
Louis Wasserman, Florida
Zack Wilson, California
William Worland, Indiana
Ron Yater, Indiana
Yeo Buk Kwang, Singapore

Project I will consist of a series of sections, eventually covering all of the color varieties - how the top breeders handle the different color strains...what happens when colors are outcrossed, how breeders are selected, etc. Since different strains of the same color often react differently, we have attempted to trace the strains being discussed as closely as possible. We hope that by including enough strains, patterns of similarity will emerge and possibly it can be pinned down. Again our thanks to all the breeders who have made this series possible.

Previous sections: Section I Breeding the Blues (GR, Nov. 197)
Section II Breeding the Half Blacks (GR, Jan. 1972)
Section III Breeding the Swordtails (GR, July 1972)
Section IV Breeding the Greens (GR, March 1973)
Section V Breeding the Reds (GR, Sept. 1974)
Section VI Breeding the Yellows (GR, Dec. 1974)
Section VII Breeding the Mutts (GR, March 1975)

ADVANCED GUPPYIST PANEL - PROJECT 1

THE TECHNIQUES OF BREEDING SPECIFIC COLOR VARIETIES

SECTION VIII - BREEDING THE SNAKESKINS SNAKESKIN STRAINS REPRESENTED

Started with a single male acquired 3 years ago origin unknown. Outcrossed into a female from Regent pure green strain (Mike Regent

#2 Started with a single snakeskin male from Richard Busch of Germany. It is not known if it was a pure strain. Outcrossed to females of pure HI red strain which carries albino (Midge Hi-)

#3 This was just an average pure strain when I started to work with it three years ago. (Wm Ihlg)

#4 I do not know any background of the snakeskin stock I acquired and used in breeding my snakeskins (Dale Marteeny

#5 Started with a single Krypta green snakeskin male which I outcrossed to grey-bodied females from Hi Hi Black green strain which has been kept pure for 8 years. Have worked with the snakeskins for 4 years. (Midge Hi-)

#6 Started with a single red snakeskin, background unknown, crossed to females from pure Gorsky Red strain. (Leroy Pierce)

Not much detail is listed as to the origins of the snakeskins used to begin any of these lines. All except #3 outcrossed the original snakeskin into one or more of their own pure color strains, most of which have already been studied in previous sections. So, like the mollies, we are once again dealing with total outcrosses into one pure strain. Do the breeders of snakeskins intend to outcross freely as do the molly breeders, or do they attempt to purify their snakeskin stock?

FEATURES OF SNAKESKIN STOCK AS COMPARED TO AVERAGE (blank space = average)

	#1	#2	#3	#4	#5	#6
Size		smaller	larger		wider	larger
Tail width		wider	wider	wider		
Dorsal	Smaller	Wavy *2	smaller	smaller	*5	larger
Growth rate			faster	faster	slower	
Maturity rate	later		earlier	earlier	later	
Fertility	more		more	more		
Cannibalism	more			less	less	less
Susceptibility to disease	*1		*4	less	less	less
Deformities		some *3		less		*6
stronger/weaker			stronger		stronger	
Other						

#1 Have very little anything with any disease

#2 Dorsal very outstanding for snakeskins

#3 Bent spines

#4 About the same or a little better than other strains

#5 Quite variable

#6 Some but very few

Here again we see the typical effects of hybrid vigor resulting from outcrosses. It should be noted, however, that #3 which is listed as a pure strain, shows the same size and robustness. Perhaps some of the size and vigor is genetically linked to the snakeskin pattern. Snakeskin dorsals seem to go to extremes with 3 out of 6 having smaller than average dorsals, 2 out of 6 having larger than average dorsals, and one producing quite variable dorsal sizes. It would appear that snakeskins tend toward superior vigor which

[redacted]

Started with an outcross of a single snakeskin male into females of an established pure green strain. The first generation males did not look like their father but had more sooty colorals that were more towards the base colors. After 3 years of inbreeding and backcrossing into the original pure green strain, the young are now fairly uniform with 50% of the desired color. Some of the others show tan-colored spots.

#2 Started with an outcross of a single snakeskin male into females of a well-established pure red strain which carries albino. The first generation had females with snakeskin markings. All were reds with wider reds than the pure red strain and less black markings than the father's did. The snakeskin pattern showed up in 50% of the males in the F2 indicating that the snakeskin pattern was carried on the X chromosome instead of on the Y chromosome as is usually the case. Albinos also showed up in the F2. After 4 years of outbreeding but inbreeding, the line produces four different types of males which are fairly uniform within each type: snakeskins, albino snakeskins, reds and red albinos. The snakeskins have spotted dorsals but the spots do not appear on non-snakeskin caudals. This line has been purposely bred to retain the four different kinds of males.

#3 Started with a pure strain which produced in the first generation males which were like the parents. After 3 years of inbreeding and backbreeding, the young are fairly uniform in colorful pattern, body size and dorsal. 80% are the desired color with 20% having yellow-green markings at the base of the tail.

#4 - The males of the first generation from the original outcross were like the father. Using nothing but total outcrosses for each new generation, the line now produces 100% snakeskin males that are fairly uniform with 95% being the desired color.

#5 - Started with an outcross of a single snakeskin male into females of a pure color strain. The first generation males all showed the snakeskin pattern but were much greener in color, and bodies were much larger than the original female. After 3 years of continually breeding the snakeskins back to the pure strain females, all males are now fairly uniform with 80% of the desired color and 20% showing a random yellow spotting in the caudals.

#6 Started with an outcross of a single snakeskin male into females of a pure red strain. The first generation produces snakeskin males with more red color in the caudal than the father had, and also larger dorsals with more color. After continual breeding of the biggest and best snakeskin male from each generation back to the same pure red strain, the males results are now fairly uniform with 80% with red caudals and about 20% with black spots in dorsal and caudal. One or two males from each litter come out a beautiful red with no snakeskin markings.

One thing should be very obvious from the above data on most of the snakeskin lines, the male passes the snakeskin pattern on to the vast majority of his sons. This indicates that the snakeskin pattern is being carried on the Y chromosome. This genetic linkage allows the breeder of snakeskins, in general, to cross his snakeskin males with any female and so I produce young showing the snakeskin pattern. It also means

that breeding a non-snakeskin male into one of the females from the snakeskin line would result in 100% non-snakeskin males and this is often done (see the section on breeding the Yellows.)

#2 is the exception to the rule as the snakeskin pattern has proved to be carried on the X-chromosome. This in turn means that the females of the line pass the pattern on to the young males (since the male's X-chromosome can pass only to his daughters.) This makes for a whole different ball game as in this case it is possible to mate any non-snakeskin male to a female from this X-linked snakeskin line and get from 50-100% snakeskin males (depending on whether the female carried the snakeskin trait on one or both of her "X-chromosomes). This type of snakeskin linkage is unusual and is not often seen, but it should be suspected immediately if no snakeskin fry result from a snakeskin male breeding...or if snakeskins appear from a breeding using a non-snakeskin male.

Since it is known that an X-linked snakeskin gene is in existence, it is possible that someone somewhere has crossed a Y-linked snakeskin to an X-linked snakeskin and thus produced a snakeskin line in which both males and females can carry the pattern. Since there is no visible difference between the Y-linked snakeskin pattern and the X-linked snakeskin pattern, only a little experimenting with test crosses can reveal which type(s) are present in a given snakeskin line. Although it might be added here that the X-linked snakeskin pattern is so seldom seen that it would be safe to assume that most snakeskin males you might run across are Y-linked snakeskins.

WHAT DO THESE BREEDERS DO ABOUT COLOR IMPURITIES?

#1 - No problem with impurities.

#2 - I am attempting to breed the black spots out of the caudal so pick the purest red tails. Black spots apparently linked with the snakeskin pattern because the non-snakeskin reds and albinos have solid red tails...the black persists only in snakeskin siblings.

#3 - Use selective breeding.

#4 - Selective breeding used to remove any spots in caudal.

#5 - By selecting the most solid green male to breed back to the pure strain females. I separate all females resulting from the snakeskin to solid green crosses and breed snakeskins back to the pure line only...in each generation.

#6 - Select pure red strain females showing the least black to breed to snakeskin males with the most solid color caudals and dorsals.

Here we see that even though IFGA standards do not specify a solid color caudal on snakeskin males, all of these breeders are attempting to breed from the spotted tails so often carried by snakeskins. Since four out of six are repeatedly breeding snakeskins into pure, solid color females, the chances of purifying the caudal color of the snakeskins are quite high, even though caudal spotting may be quite stubbornly linked with the snakeskin pattern.

ENVIRONMENTAL OR DIETARY FACTORS AFFECTING COLORS IN SNAKESKINS

#1 - Don't know of any. My fish are in various areas with no changes of colors.

#2 - Salt and trace elements intensify the red color on body and fins. Various foods also brighten the red when fed daily. Black bottom tanks usually make the snakeskin pattern more pronounced, but tend to muddy the red caudal color.

#3 - Natural daylight with the sun rays removed intensifies color. The color gets better with age. Water conditions do not seem to make much difference. The fish retain good color regardless of water conditions: green water, clear water, cloudy water, hard or soft water, acid or alkaline water, etc.

#4 - None.

#5 - Feeding sun-dried shrimp brightens the iridescence of the green. It even gives a shiny, greenish cast to the female bodies.

#6 - None.

Although the intensity of color in the snakeskin body pattern and the percentage of the body it covers is quite widely varied from snakeskin to snakeskin, it is probably due largely to genetic factors since these breeders of snakeskins do not report that environment or diet make much difference to the snakeskin pattern itself, although the overall coloration of snakeskins react in the same general way as for non-snakeskins to specific variations of environment or feeding.

METHODS OF BREEDING TO RETAIN OR IMPROVE COLOR

	#1	#2	#3	#4	#5	#6
INBREEDING	X	X	X			
Sibling cross	X	X	X			
Mother/son cross						
Father/daughter cross			X			
LINE BREEDING	X		X			
# of lines kept	2		2-4			
Crossed after how many generations?	4-5		2			
CONTROLLED HYBRIDS						
CROSS TO DIFFERENT BODY COLOR		X *2				
TOTAL OUTCROSS				X *3		
OTHER	X *1				X *4	X *5

*1 - Back cross every 4th or 5th generation to same pure-green strain used to start this line.

*2 - All are siblings. Breeders selected so as to maintain all 4 varieties in this line: red snakeskins, albino snakes, reds & red albinos.

*3 - Total outcross every time...to give hybrid vigor.

*4 - Always breed snakeskins to females from the original pure strain. Always discard all females of snakeskin matings.

*5 - Always breed biggest and best snakeskin male back to the original red strain females.

Looking at the chart above we see several breeders of snakeskins using a breeding method that is seldom used when breeding the other colors continual breeding through females from a specific pure strain. #5 and #6 use this method exclusively. #4 continually outcrosses his snakeskin males into other pure strains but does not always use the same strain. None of these three breeders use the females of the resulting snakeskin litters for breeding. #5 reports discarding these females as soon as they are sexable, and it is likely the other two also do not bother to raise the unused females. The fact that females from other pure strains are used for a double purpose to further the pure strain and to breed to snakeskins for snakeskin young can save much-needed space in the fishroom as less tanks are needed to maintain females. This is one very handy

reason for using these rather anorthodox breeding methods, made possible by the fact that the snakeskin males (in the majority of cases) produce snakeskin sons no matter what female he is bred to.

But a still better reason for using this method of breeding becomes obvious when we take a look at some of the undesirable features these breeders report as linked closely with the snakeskin patterns, small and/or shorter dorsals, spotted finnage, uneven caudal growth, dorsals consistently lighter in color, tails that do not grow to 1 to 1 ratio, etc. These undesirable features can be minimized and solid color improved at the same time by constant breeding through females of good pure strains.

#1 breeds back into the original pure strain only about every 4th or 5th generation, using inbreeding and linebreeding of the snake line in between times. #3, the only breeder to start with a pure snakeskin strain, continues to keep his strain pure by using only inbreeding and linebreeding techniques. #2, whose fish carry the snakeskin pattern on the X-chromosome, cannot make use of the method of breeding the snakeskin males to females of other lines because the result would be 100% non-snakeskins. While it would be possible for this breeder to do a reverse of this technique and continually breed non-snakeskin males of a pure strain into females of the snakeskin line, this was not done because the hybrid snakeskin line produced better tail width which could only be maintained by using males from the line (possibly carried only by the males). If this had not been the case, the line could probably have been improved more quickly as to body size and solid caudal color by breeding the pure red strain males (with albino through the females from the snakeskin line... at the same time retaining the four varieties being bred for.

No mention was made as to whether or not the snakeskin pattern stayed just as intense or covered the same amount of the male's body, although #6 did report problems with black 'smudges' on the peduncles of many of the snakeskin males, which would cause a reduction of the percentage of body displaying snakeskin markings. It has been suspected that constant breeding of snakeskins into non-snakeskin strains would gradually cause a breaking-up, coarsening or fading of the snakeskin markings. If such is truly the case, it apparently has not caused much trouble so far for these breeders, because nowhere in any of the reports was there any mention of problems with the snakeskin pattern itself.

It should also be mentioned here that some of these reports were submitted during the time when the "cobra" (which had vertical zebrinous bars on the peduncle) was still included in the snakeskin classification.

Since then the 'cobra' markings have been deleted from the snakeskin classification, and the vertical zebrinous bars are now considered undesirable since they interrupt the continuous snakeskin pattern which should cover as much of the body as possible. These breeders reporting while the 'cobra' bars were included, did not have to worry about picking up the zebrinous bars from outcrosses. Now more care must be taken when choosing strains to breed snakeskins through as a number of the pure color strains do carry the zebrinous pattern....which in turn would show up in some of the resulting snakeskin young, thereby lowering their quality as show fish.

METHODS OF BREEDING TO MAINTAIN THE OVERALL QUALITY OF SNAKESKINS

	#1	#2	#3	#4	#5	#6
Inbreeding	X	X	X			
Linebreeding	X		X			
Total outcrossing				X		
Back crossing to the same pure line	X				X	X

Every one of these breeders uses exactly the same breeding techniques to maintain and improve the overall quality of their snakeskins as they use to maintain and improve the color, and probably for the same reasons as discussed previously.

METHODS OF BREEDING TO PRODUCE SHOW FISH

None of these breeders do anything different than the breeding programs already discussed to produce show fish. Obviously they consistently get results to their liking from the breeding techniques already outlined.... on all three counts: color, overall features and show quality.

OUTCROSSES...THE EFFECT ON COLOR

Snakeskin x	Results
Blue	#4 - Good to excellent #5 - Good. Got both blue and green-tailed snakeskins.
Green	#1 - Excellent. This was the basic cross and is still crossed back to every 4-5 generations. #4 - Good to excellent #5 - Different green strain. OK, tails more apple green
Red	#2 - Excellent. This was the original cross and proved highly compatible. #3 - Poor. All male snakeskins had either red tails with heavy spotting or yellowish-white tails with black blotches. Tails never grew to proper length although dorsals were larger. #6 - Very good. This was the initial cross and has been used as the back cross ever since.
Purple	#4 - Good to excellent. Dorsals do not match caudal #5 - Excellent. Very big body size, tails green to purple...greens were solid, purples had spots.
Albino	#2 - Very good. Initial cross was to a red/albino hybrid. Some uneven tail growth occurs on albino snakeskins but does not occur on the other three varieties coming out of the same line.
Yellow	#5 - Poor. Picked up much spotting on the tail. Lost some dorsal size.
Half Black Blue	#5 - Got 100% brilliant black and yellow spotted tails on half black bodies with snakeskin markings on the shoulders. Huge body size!

Apparently the majority of snakeskin outcrosses come out quite well. There seems to be a tendency to increase spotting of the tail on some of the outcrosses probably because snakeskins are so prone to this trait anyway that the least presence of that impurity in the outcross strain is immediately picked up. It is not surprising that this shows up most in the yellow and red crosses since they are also more prone to spotting. It is, however, rather a surprise to see brilliant black and yellow caudals come out of a cross between a green snakeskin and a half black blue female. Snakeskins seem to have carried their larger than average body size to most of the outcrosses which reported on the size- factor. If so, the snakeskin apparently needs to be crossed to a strain that has good dorsals in order to produce respectable dorsal size since the snakeskins seem generally weaker in dorsal features.

IF ALL THE SNAKESKIN LINE WAS LOST EXCEPT ONE LONE MALE...WHAT WOULD EACH BREEDER CONSIDER TO BE THE BEST OUTCROSS TO PRESERVE THE COLOR?

#1 - Green female, because this was the original cross and is used for back crossing. Would expect good to excellent results

#2 - Red female that carries albino. This was the original cross and a back cross to it would maintain the color and the presence of the albino. Would expect all non-snakeskin males (both grey and albino) in the F1. Snakeskin males would again appear in F-2 with quality the same or better than before

#3 - Blue female because the snakeskin pattern would be retained and the color is the same as the blue snakeskins. Would expect all snakeskin males.

#4 Female of any desired color because the male is Y linked and would carry the snakeskin pattern. Would expect 100% snakeskin males

#5 - Green female because that is the way I breed the snakeskin line anyway. Would expect green snakeskin males of high quality

#6 Red female because that is the strain I breed them through anyway. The red females seem to carry the large dorsal and large caudal. I would expect 98% snakeskin males marked like the others

This wasn't much of a question for 5 out of 6 of these breeders, who either breed this way routinely or maintain the same strain to which they outcrossed the original snakeskin male. Only #3, who started with a pure snakeskin strain and kept it that way, would have to breed any differently than usual. He would be forced to outcross his pure strain, but based on the experiences of the others he should stand a good chance to come up with high quality snakeskins of he had a good compatible cross. He then could either go back to inbreeding and line breeding the new hybrid line, or he could adopt the methods used by the others and keep breeding each generation of snakeskins back into the females of the outcross strain.

BREEDING GOALS

- At present just maintaining the snakeskin line and have gone to six generations for backcross to green strain

#2 - Good solid red caudals on snakeskins, good albinos and albino snakeskins, red males without a black saddle. Also to add more body size to the snakes

#3 - To keep the strain where it is and hope for improvements, especially in the male dorsal and the female caudal and dorsal

#4 - Solid green, or any other solid color...caudal. Also to put a good dorsal on the snakeskins.

#5 - Snakeskins with large bodies that have colorful, distinct snakeskin patterns on entire body, large, solid-color delta tails with big flowing dorsals.

#6 - All females to have delta or superwide caudal. To get color as free from impurities as possible

More solid colors and larger dorsals seem to be the most general goals of these breeders. It is interesting to note that both breeders who used red strains in their outcrosses report larger than average dorsals, while the rest seem to have more trouble with dorsal size. Some red strains have exceptionally large dorsals which seem to be passed along by the females to the outcross hybrids even to the snakeskins which are not in themselves usually endowed with overly large dorsals. Apparently dorsal size of other solid color strains is less dominant and has a harder time overcoming the snakeskin tendency to smaller dorsals

SELECTING FEMALE BREEDERS

A short thick peduncled female with a box tail

#2 A large, short, stubby body with no body color. Some females from this line have much red in the peduncle, but using them for breeding has produced troubles. A big delta caudal as even a red as possible but especially look for red in lower quarter of tail. Elongated dorsal.

#3 Well rounded body with good size and shape and with as much color as possible. A large caudal that is either blue or is without a pattern. A large well formed dorsal

#4 A large body with good shape, color and C/R ratio. Caudal color

#5 - A large but short and chunky body with a wide peduncle. The C/R ratio is very important. Caudal size is not important but shape should be superbe with good width and solid green color. Dorsal rectangular and elongated

#6 - At least 2 1/4" long body, deep through the chest and with a C/R ratio of 2 1/2 to 3, or as close as possible. The caudal should be delta shaped and show some red color. Dorsal should be elongated. I also look for a large gravid spot

		#1	#2	#3	#4	#5	#6
C/R ratio		x	x	x	x	x	x
Body:	size		x	x	x	x	x
	shape	x	x	x	x	x	x
	color		x*1	x	x		
Caudal:	size		x	x			
	shape	x	x			x	x
	color		x	x	x	x	x
Dorsal	shape		x	x		x	x
Other							x*2

*1 Lack of color

*2 Large gravid spot

Body shape and C/R ratio (ratio of length to width in peduncle) are unanimously looked for by all these breeders when selecting females for breeding snakeskin lines. Body size and caudal color are collectively considered the next most important criteria (5 out of 6), followed by caudal and dorsal shape (4 out of 6). There is nothing very unusual about the qualities these snakeskin breeders look for when selecting female breeders probably because so many of them are using females from their own well-established pure color strains which, in most cases, produce consistently good females that are fairly uniform.

The only unusual thing reported was that #2 has had difficulties when breeding females that showed red color on the peduncle area. Since most breeders seem to prefer as much color as possible on the female, it is worth noting that color on females can sometimes cause problems, although there are no clues as to why this should be.

SELECTING MALE BREEDERS

#1 - I look for all the traits listed plus slow maturity

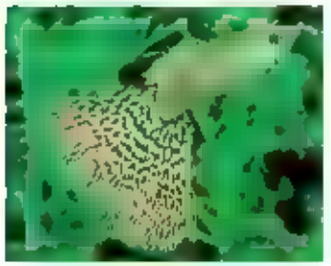
#2 A short body with a wide peduncle and a distinct snakeskin pattern over the entire body with little or no sign of black saddle on the peduncle. A large size if all else is good. The largest, widest tail with the least black markings and no sign of raggedness. A dorsal that is large and flowing and has as few black spots as possible

#3 A large, well-rounded body with as much color as possible. A large, well-formed blue caudal without a pattern in it. A large matching dorsal with a good shape.

#4 - I look for the best in all factors mentioned, but especially for a wide, short peduncle.

#5 A large body with a wide peduncle. Body must have a green background with a distinct even snakeskin pattern with no big black spots. The caudal must have good length and width and be a solid green color. The dorsal should match and be as long and wide as possible

#6 - A large, well-rounded red body with good snakeskin markings. Caudal must be wide, as solid red as possible, and must be as long as the body, dorsal should be large, elongated and solid red



LINE BREEDING

by Joseph L. Tupper Jr

When the subject of line breeding is brought up, most fanciers regard it as the breeding of closely related fish which come from parents exhibiting desired traits. At most they will have some appreciation of the need of periodically crossing their strains with like fish from other fanciers.

There is more to it than this. Proper line breeding not only allows the breeder to maintain a desired strain and to fix new types which crop up, but also, if coupled with some knowledge of trait inheritance, to develop new strains or improve old ones.

Select the two best (of your stock) and breed them back to the parents, mother with son and father with daughter. This fixes your parental lines.

These two lines are now line bred with brother/sister crosses using the best pair from each successive generation for from four to five generations. How many inbred generations you can use without weakening your line depends on how robust your stock was to start, with and what mutation rate you experience. Each generation must be culled ruthlessly to only a few pair, and the best male and female mated for the next step.

After your line has been inbred for four to five generations, you select your best pair from each of the two lines your original breeding gave you, and you cross between the lines the male from one line with the female from the other, and the female from the first line with the male of the other.

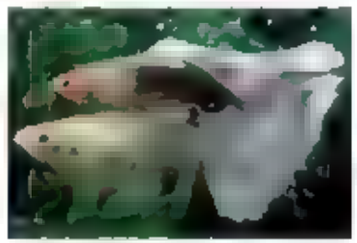
Again you conserve your breeders because following your outcross, you re-establish your lines by breeding mother/son and father/daughter on both sides of this cross. This will give you four lines. If you take the better line from each of your new units and continue inbreeding with your new parallel lines, this sequence can be continued indefinitely and in each unit of inbreeding you are building up a series of generations of fish which are only distantly related to each other. Each time you cross lines, it has the effect of bringing in unrelated stock.

If you remember to select and cull, select and cull, and to maintain your parallel lines for your crosses, you can improve your fish immensely in a few generations.

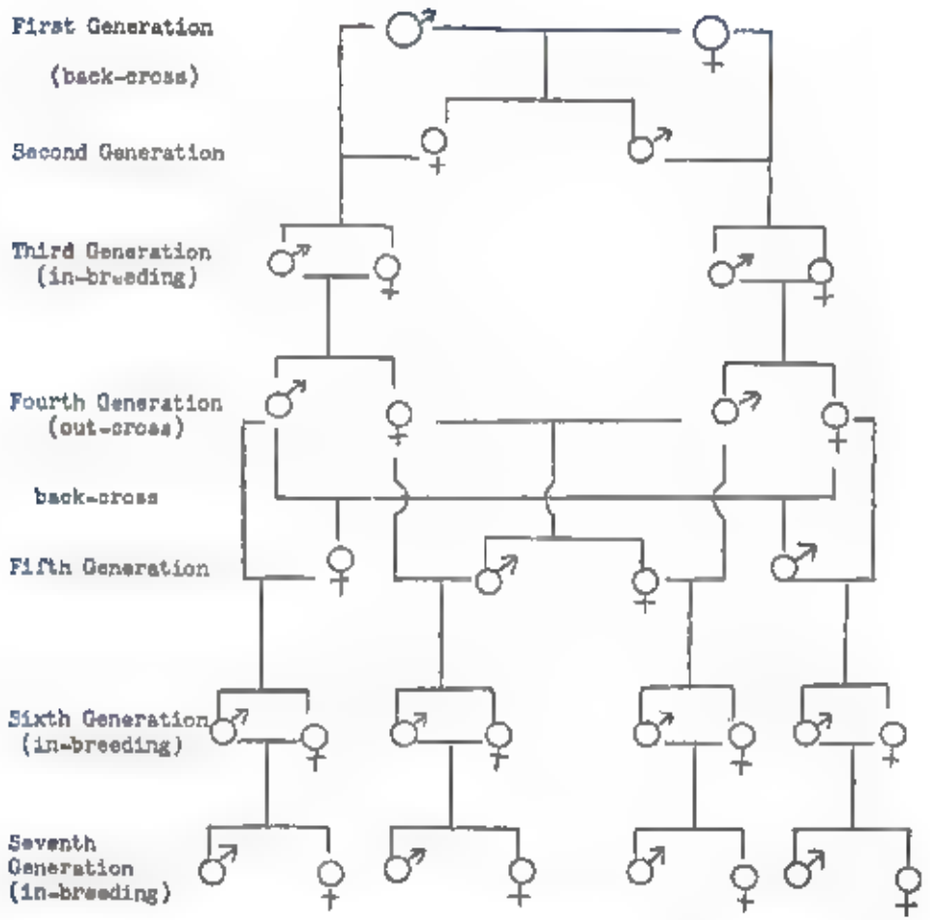
The diagram on the next page shows in simplified form the original breeding and steps to fix the first two and then four lines, by back-crossing at appropriate points (i.e. mother/son, father/daughter), crossing and inbreeding (brother/sister) between lines.

(The above are excerpts from an extensive article in the January, 1974 "Wet Pet Gazette" as reprinted in "The Fish Tale", May-June 1974.)

See chart >



LINE BREEDING DIAGRAM



The above diagram shows a simplified form of the initial breeding and steps to fix the first two and then four lines by back-crossing at appropriate points (i.e. mother-son/father-daughter crossing and in-breeding brother-sister) between times

SELECTING BREEDERS

by Elvis Bryant

Before we go into detail on breeding, let me straighten the misconception that people in general have about guppies..."Guppies, you just put 5 males and 5 females and let nature take its course" Well, nothing can be farther from the truth No one can breed good guppies this way; there is too much chance that some will be bad, and, of course nobody can predict a certain female's offspring in advance

The most positive way to select breeders is to first determine what you want. Is it size, color, or both? One way may bring color but will lack size, another way may increase body size but lose color Now you have taken that step, you want size and color together

Male first...I watch the caudal region, what I want first is a delta caudal. I watch all my males for a good 60 degree spread. Next, I want my male to be a good solid in the caudal region. Next BODY size. I select the largest body size with all the requirements I desire in the two steps mentioned above.

You may have males with all the factors. In most cases good guppy breeders will have a dozen males to select from, but try to cull these down to two.

Females are very difficult to select. Carefully watch the females for color in the caudal area

A CLEAR region in the caudal is most desirable for blotches of mixed colors can be a lot of trouble. Next size of caudal. Pick a female with a nice high-swept caudal.

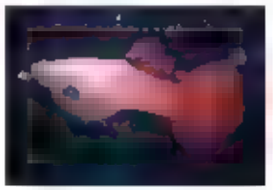
Next the membrane (**PEDUNCLE**) has in the region before the caudal. Pick your female because of a thick membrane in this area. The thick membrane will help the offspring muscles to hold the large caudal

SHAPE - Be especially careful for shape. This can be dangerous if you pick a female with a crooked spine. Sometimes an overhead view is best to determine this. A strong light to view these areas is always helpful. If you waste six months breeding only to find you used a female that had a crooked spine you may be a little mad

SIZE - If you have cleared the three areas covered, you now can look for the largest female with all the characteristics mentioned before

TRIOS...one male, two females...are the best. I believe control is the best answer for using a trio. When the females are beginning to fill up with roe, separate them. You are better able to determine the quality of the young. Be sure to label each to tell months later from which female the young came. You may have a regret if all the young are mixed.

A young female may not have many young at first, but as she matures the amount of young will increase. By young I mean 4 to 6 months old. An older female does not mean better young. In fact, it is found to be opposite. Then after three groups of young, you will find it best not to take any more young from this female as she would be past her prime age



EXCERPTS ON BREEDING

The Importance of Selecting good Breeders

by Bob Harris (The Kribun 1971)

Choosing the best guppies for breeding has always been a problem. When most people are preparing to choose their fish, they tend to look at the males and more or less forget about the females. Many people who cannot choose proper females, even though they have the proper males, will eventually lose. When you come right down to it, the females are more important in the breeding process than the male as in some strains the female guppy may have as much as 60% of the characteristics which the offspring will inherit the male 40%. Therefore it is a real guppy breeder who can choose the females. The males are simple by comparison.

Since it is a most impossible to get all of the desired characteristics in one fish, you must break it down. Most breeders use different lines of fish for different characteristics. One for the tail shape, one for tail color, one for body size, one for dorsal color, etc. After awhile you can combine a few of these characteristics in one strain. All this is for just one color strain of fish.

Selecting Breeders

by Warren E. Young (Love Tails June 1971)

The female has a lot to do about the size and finnage of the next generation and also a good deal about color. The majority of good guppy breeders do their breeding by trios, a combination of one male and two females. The idea is to find out what combination is producing the fish that he is after. I usually mark my females by cutting the top of one tail and the bottom of the other. The fry will be kept in separate tanks. In two or three months we can tell if we have a good pair. If not keep trying females until we get what we want, and it won't be long before you are producing good fish.

The question always arises that why don't all your females throw good fish in following generations. The better your line is set, the better your chances, but for some unknown reason, fish will go backwards toward their original state much faster than they will go forward. So it is always a battle to find the right females.

Disadvantages of Inbreeding

Dr E Schmidt (TFH Jan. 1965)

Besides having many advantages, inbreeding also has considerable disadvantages which almost always lead to failure. When we aim for certain characteristics by inbreeding, a number of traits become irretrievably lost. Loss of vitality would head the list. In contrast to luxuriating, the stock can be said to be pauperized.

Another example serves to show that it can sometimes be impossible to combine two favorable qualities. We find the most highly differentiated color patterns with guppies of small size. The best known in Europe are the unusually lovely emerald green Vienna guppies. If we attempt to carry over this finely etched pattern to the larger-bodied guppies, it becomes pulled apart and the innate character of its delicacy is lost.

DEVELOPING NEW CHARACTERISTICS THROUGH MUTATIONS.

If you want to come up with something new in the way of guppies, keep a sharp eye out for the unusual in your rearing tanks. Chance mutations spotted by serious breeders are probably responsible for the fine finnage we have on guppies today. Combined with careful breeding programs many of these mutations have become established and true breeding.

SEEK AND YE SHALL FIND

by Brian Newman

Mutations are not rare, they occur frequently, but most pass unnoticed. Consider some of todays' fish which are the result of mutations, the lordly betta, the multi-colored platies and swordtails, the popular and beautiful veil tail guppy. In recent years hobbyists have become more aware and more observant, thus the increase in new variatys.

Of course, not all odd fish we see are true mutations. Many such fish are deformed as a result of damage sustained by embryos.... congenital defects. How can the average hobbyist distinguish a congenital defect from a true mutation?

First of all let us look at some of the basic forms a mutation can take. longer or differently shaped finnage, excess black pigment, lack of pigment, etc. Prime examples of finnage variations are the hi-fin swords and veil tail angels, excess black pigment is exhibited by the black molly, lack of pigment by the albino fish, although fish such as the gold guppy also show a partial lack of pigmentation. Generally speaking, color variations are not congenital.

Assuming that a suspected mutant has been discovered, the work of the hobbyist has just begun, as there is only one true test of a mutation. This test involves the development of a true-breeding strain, all young of which will exhibit the new characteristic. Before the work is commenced, the breeder must ask himself if the suspected mutation is worth the time and effort involved to get it to the market place. Remember, not all mutations are attractive, some can be downright ugly. However, when the decision is made one factor which should influence the thinking of the hobbyist is... what would the fish look like if the variation was intensified? For example, a dusky variation may, by selective breeding be developed into solid black. Similarly, a rust or pink mutation could become orange or red.

Having made his decision, the next step is to see if the suspected mutation is bonafide. If there are a number of affected individuals, and two are of the opposite sexes, the best plan is to mate these two together. The next method is to mate the fish back to its parent, if possible. If this is not possible, the mating should then be made to a brother or sister. The idea here is to attempt to concentrate the genes responsible for causing the original variation from the norm. If the mutation is dominant, a percentage of the young should exhibit the desired characteristics. If however, you find no fry resembling the parent being tested, do not give up hope. The mutation may be recessive. Thus, in order to produce a further concentration of the desired genes, one or more of the first generation offspring should be bred back to the affected parent, or, if this is not feasible, the young should be interbred, brother to sister.

If as the second generation young develop, the desired characteristics are not evident, it can safely be assumed that the variation was indeed, a congenital defect, not a true mutation and we must return to our rearing tanks and begin our search anew.

So...seek and ye shall find. This means everyone. Mutations are not the result of experience,... the beginning aquarist is just as likely to have one in his first spawning as is the old pro in his thousandth. Happy hunting.

(Condensed from "The Valley Stream", Dec. 1971)

WHAT IS A MUTATION

by Midge Hill

What causes mutation in the first place? What is a mutation?

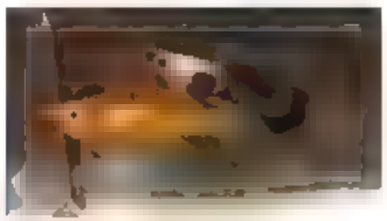
Heredity is basically self-reproduction, and the units of self-reproduction are the genes. Usually genes create exact copies of themselves, but once in a while something goes wrong with the copying process, and a gene is formed that varies in some way from the original. This change can affect a vital function, it can be as accidental as a minor color change, it can be as dramatic as adding a double dorsal fin, etc.

Mutations arise from time to time in all organisms and have been fairly frequent in the prolific guppy. Although mutations have changed the short tails of the wild guppy into today's wide delta fins, mutations are by no means limited to fin shape. They can affect color of body and fins, size or shape of body or fins, fertility, growth rate, behavior, internal structures, bodily functions, etc. With some mutations visual differences are almost non-existent, others are quite obvious. Still others, the vast majority, produce changes so drastic that the organism dies in the embryonic stage or shortly after birth. Most mutations are harmful to the individual in the environment in which they occur.

Experiments have shown that the percentage of mutations can be increased by certain environmental factors: X-Ray, ultraviolet rays, high temperatures, the use of certain chemicals, etc. An even easier way that has worked more than once for me, is to keep a female virgin until almost two years old. One such two year old female when bred (breeding doesn't always take at this ripe age) produced just one litter before dying of the shock of it all. However, in that one litter was one albino (Apparently a true mutant as the albinism occurs on a different gene from any other albino I have ever found in the 15 years I have worked with this species) and two pairs of siamese twins. Another virgin bred for the 1st time at about 18 months threw two fry with double dorsal fins. (Unfortunately, careful breeding of a number of generations of fry from one of these unusual fish never produced another double dorsal...leading to the belief that the 'error' occured in the process of cell division rather than altering the hereditary pattern.)

Even though the majority of mutations are of little use to either the breeder or the guppy itself, an alert breeder can sometimes spot a mutation which makes possible a new characteristic for our guppys. And much progress can be made if it is remembered that mutations need not be only used to enhance the outward appearance of the guppy. Mutations can be used to breed more disease-resistant fish, fish with more active mating displays, fish with more or less aggressive personalities...the list is endless.

(Condensed from 'Guppy Roundtable", February 1970)



INDUCING MUTATIONS

by Harry Matson

It is not every day that one gets a call from a friend who asks if one wants the use of an X-ray machine for experimental purposes. It was just such a call which I received almost two years ago from Stan Mruk of Chicago after he had conducted an experiment with an X-ray treatment of some guppies. He informed me of his results and suggested an experiment of my own, offering me the use of the X-ray machine.

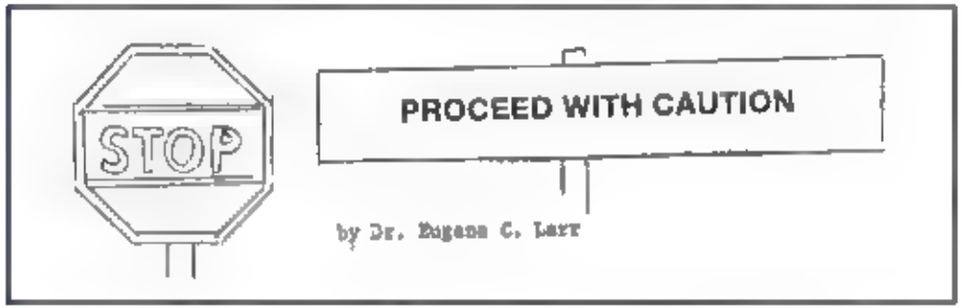
One week before I gave some of my own guppies an X-ray treatment. Stan had given some of his fish 5000 roetgen for five minutes. Stan did not notice any ill effects on the fish, but as a matter of fact said that he had never seen any fish so active.

I was glad to accept the use of the X-ray machine, inasmuch as several of our local club discussions were spent speculating as to how we could possibly upset the genetics of our fish. Furthermore, I had noticed that everytime I got a decent yellow strain going, a lot of black pigmentation cropped up from time to time. I had also noticed that a good many times when blacks were exhibited, or somewhat excited or frightened, they would show up as a darkened yellow or an olive green. Unless the breeder used anise or some other coloring agent, I therefore felt that this was an opportunity to see if, with the X-ray, I could make yellow guppies produce black.

I exposed some pregnant females to 10,000 roetgen for five minutes. Pregnant females were used so that I might at least have some young stock to work with had the subjects died shortly after the treatment. Contrary to my expectations, the treatment had no stunning effect. Two weeks later the treatment, the first fry were born, and fry continued to be born every twenty-one days thereafter.

At the age of one month it was apparent that there were a lot of black young, and these developed perfectly until the age of three months. At that stage of development, every black-tailed male died. This pattern continued for six generations...one third of each brood being black. The yellow fish always did well, on the other hand, for the care that they received.

It is not the intention of GR to call down anyone who has written article, but we feel that it is part of our job to help breeders get the right information. Since it has been pointed out that GR has been guilty of passing along some questionable information, we would like to correct it at this time and urge everyone to go back to the July 1971 issue of GR and mark a big question mark through the article on swordtail genetics, and please exchange editors, do not reprint the July article - there is enough misinformation passing around unwittingly without adding this questionable article to the lot.



On page 6 of the July issue of GR appears an article on the Genetics of Swordtails. I don't know who this gentleman is, but I see that it is a reprint. There are four big genetic mistakes which should be clarified at this time.

1. **The top swordtail factor is not carried on the X chromosome.**
2. **The bottom swordtail factors are not carried on the Y chromosome.**
3. **The double swordtail is not a combination controlled only by the X and Y chromosomes.**
4. **The dorsal length factor is not located on the Y chromosome.**

These are three traits...top sword, bottom sword and dorsal - that were explored so thoroughly in the early days of guppy genetics that I am surprised that this gentleman is making this point. If he does have a strain of fish that actually displays this, much of the basic work that has been done way, way back will have to be thrown out. So universal have the findings been on this subject, that it is safe to say that the 'facts' that the gentleman states in the article simply are not true!

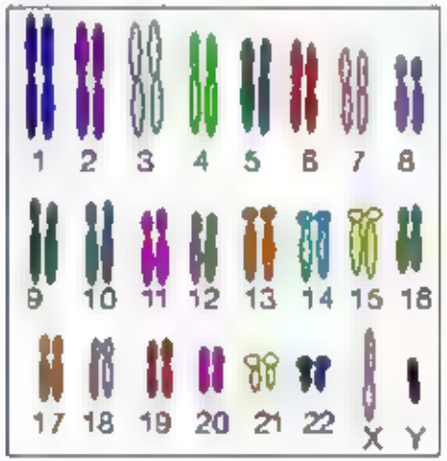
I personally have worked with top, bottom and double swords to try to find links that were on the sex chromosomes, because this was a thought that was put forth in a lot of the old literature. And I have tried this many, many times, and I have made crosses into literally thousands of fish...and the gentleman's 'facts' simply are not true.

All of these traits are autosomal (carried on any chromosome other than the X or Y) that is, the top swordtail, bottom swordtail and dorsal characteristics, especially the length of dorsal, are autosomal traits. If it were as simple as he said and these traits were sex linked instead of autosomal, these characteristics could be easily set. Let's pretend for a moment that the dorsal length factor is carried on the Y chromosome. If this were true you could look at any of your fish tanks and be able to see nothing but fish with great, big, long dorsals, because it would be so easy to pick breeder males that would show this trait and pass it on to their sons via the Y chromosome. I'm sure that by just casual looking, you yourself will know that this is not true.

So, all I can say is that this gentleman is in error. If he does have a strain of fish in which these traits are carried in that way, he has certainly found something which geneticists have been hunting for since 1892. Because all the work that has been done along that line shows that these traits are autosomal and are not sex linked in any way.

Those of you who were fortunate enough to hear Dr. H. Ideman when he spoke to the PPGA members many years ago, will recall that the swordtail was one that he really worked hard on. Now, he was doing this research work at Cal. Tech (in about 1951, 1952 or 1953)...and here, of course, he had all the paraphernalia, space, tanks and everything else necessary for this kind of genetic study. He arrived at the fact and documented it very, very beautifully, that the swordtail traits were autosomal. So we don't have to go by just what I have found. Here's another geneticist of world renown, one of the fine geneticists of our time, and he found exactly the same thing that those traits of the swordtail complex are not sex-linked. Many other geneticists through the years have all arrived at the same conclusion.

One of these days I will go through and give the step by step procedure that is necessary to prove the location of traits on the sex chromosomes. For instance, let's assume that you have a trait that you think might be Y-linked. How can you prove it? Or let's say you have a trait that you think is X-linked - how do you prove that? Of course, I think that you can see that X-linked fish are going to be much, much harder to do, but there are some very definite geometric arrangements for crossing and breeding and offspring count to establish whether or not this is truly an X-linked trait. And this might be a good article - just simply the technique of how it can be proved whether or not such and such a trait is sex-linked, and if it is sex linked, on which of the two sex chromosomes it is located.



Section 2

BREEDING THE HALF BLACKS

(Compiled by Midge Hill All rights reserved by the author on behalf of the AGP Panel 1972)

HALF BLACK STRAINS REPRESENTED

#1 Ahler's Black Orchids (newly developed 4-1/2 years ago

#2 - Half Black Red from Fred Samuelson (acquired 4 years ago, outcrossed several ways to make 6 strains used for crossing.)

#3 - Half Black Pastel. Origina males from Gerhard Gellrich's German strain crossed to Zesch Greens & to Thiele's HB Reds

#4 - Half Black Pastel. Originated one year ago from solid black Half Black strain, females of which were bred to dark blue males

#5 - Half Black Pastel. Elvis Bryant strain

#6 Half Color Not Half Black 8 year pure from original pair

#7 - Half Black AOC Originated from cross of unknown Half Black male with a pink tail to a Flutter green female. 4-1/2 years ago.

Already it would seem that there is quite a different picture in the breeding of Half Blacks. In Section on Breeding the Blues, the general tendency was to keep the strains pure for generation after generation. This does not seem to be the case with the half blacks. With the exception of Strain #6, most of the ones listed are the results of fairly recent outcrosses. This is not really illogical when it is considered that at present a great many breeders are working with half blacks. Their popularity is soaring and many new color variations are being created.

It can also be assumed that the luxurious finnage and large size evident in many half blacks are great temptations to the breeder to try to breed these features into other strains. But no matter what the reason or reasons it is probably safe to say that today more breeders are working with the half black strains than with any other single color or pattern. And the fruits of their labors are turning up in increasing numbers on the show bench with almost every year seeing new half black color classes added. When all the breeding excitement settles down, it is probable that breeders will be working these newly developed strains by the conventional inbreeding and line breeding methods to set and retain the strains they have created.

FEATURES OF THE STRAINS AS COMPARED TO AVERAGE (Blank Space = Average)

	#1	#2	#3	#4	#5	#6	#7
Size	larger	larger			smaller	larger	
Tail width	wider	wider			narrower	wider	
Dorsal	bigger	bigger	bigger	bigger			bigger
Rate of Growth		slower	slower		slower		slower
Rate of Maturity		later		earlier	later	earlier	later
Fertility		less					
Cannibalism	less						
Susceptibility to disease	more*	less	**			less	less

* less deformities, an occasional runt
**some deformities, occasional bent spine

Here again we see the fantastic qualities that seem to be linked to almost every half black strain. All reported bigger dorsals and most reported the same size or larger bodies. Size and generous finnage seem to go hand in hand with the half black syndrome.

HOW THE STRAINS STARTED

Strain	Originally pure	Background
#1	no	3/4 black with purple finnage was developed from a 1/2 cross of Ahlers 3/4 black male to Ahlers red female. One of F-1 3/4 black males then was bred to a blue/green female. In F-1 about 10% were 3/4 black with purple finnage, rest were mixed.
#2	yes	The original pure strain Samuelson Half Red strain was not very prolific so crossed male into Ahlers female 2 years ago. Crossed Singapore male into resulting females 1-1/2 years ago. Now run six lines to cross back and forth.
#3	no	Original HB yellow male came from Gerhard Gellrich of Germany. Females of two different strains were used: a Zesch Green female produced fry with light green tails. Thiele HB Red females produced fry with golden and multi tails.
#4	no	Original two males came out of a solid black-tailed HB strain. These males had about 50% light blue-irridescent color and about 50% red. Two sibling females which showed the same light blue irridescance were selected but fry from these matings were disappointing, only about 2% showed desired color. Females were color tested and 3 selected for breeding back to original males. No results....so females were then bred to dark blue males. Result: 25% of the desired color.
#5	no	Stock came from Elvis Bryant and was a newly developed strain. 75% of the F-1 were like the parents.
#6	yes	Started with a pure strain that is Half Color (blue) Rather than Half Black. F-1 were like the parents.
#7	no	Began with an unknown HB male with a pink scarftail that was crossed to a Flutter Green female. A cross was made and sibbed for four generations and then backcrossed to the green strain. The F-1 were not like parents but produced BL Green and Black fry.

HOW TRUE BREEDING ARE THEY NOW?

	Time kept	Siblings now	% of desired color	% with impurities	differ... color.
#1	4-1/2 yrs.	fairly uniform	35%	10%	5% 3/4 black wit. green finnage
#2	4 years	fairly uniform	90%	10% yellow blotches in tail..or dorsal not all red.	
#3	?	somewhat varied	0%...some are solid, others spotted, hues of gold & red. Wanted yellow but did not get. The pastels were a pleasant surprise.		

	Time kept	Siblings now	% of desired color	% with impurities	% different color
#4	1 year	widely varied	25%	75% light red intermingled with blue	
#5	3 months	somewhat varied	70%	20% (red in tail, some with black in tail.)	10%
#6	3 years	like peas in a pod	90%	10% flecked	
#7	4-1/2 yrs.	fairly uniform	75%		

DO ANY PARTICULAR FEATURES SEEM TO BE LINKED TO THIS STRAIN?

#1 Large bodies, large dorsals come with about 70%

#2 Larger bodies and dorsals and wider tails.

#3 Most fish seem to be large overall although maximum caudal size develops slowly

#4 I have characteristic large dorsals common to HBs and good body size which I think is because they are hybrids. They also grow fairly fast

#5 None bred

#6 75% with big bodies

#7 Large dorsal 100% in males. Dorsals also match caudals 100%

With these kind of attributes, which seem to be fairly consistant throughout most Hd strains, is it any wonder that they have become such a popular variety to work with. The Hd females are also showstoppers with their larger than average finnage and good caudal and even dorsal color.

Looking over the above charts, two facts seem to emerge:

1. The longer the strain is worked, the higher the percentage of the desired color.

2. Some colors seem to be easier to set than others. Perhaps the moral should be... "don't give up the ship". There is only one reporting that has not as yet gotten at least 25% of the color for which he was breeding.

EFFECTS ON COLORATION OF CHEMICALS, TRACE ELEMENTS, FOODS, ETC.

This is a little more difficult subject when dealing with half blacks in general, as we are talking about many different tail colors. Something that might work for one caudal color may do nothing for another. However, they do all have in common the half black or 3/4 black body, which benefits on the how bench from having an intense black color (there is no class at present for the Half Color strains such as #6, unfortunately).

It is interesting that #3 is the only breeder listing any color additives for the half blacks ("live shrimp enhance the color") as there are several substances available known to enhance the black color and deepen it. That some of these would also tend to alter the finnage color could be a factor, although other substances have been shown to make the secondary colors more brilliant while intensifying the black. (Dr. Larry's upcoming article on color and color balance will go into more detail on this subject. Watch for it.) Once again, no breeders felt that water chemistry had to affect the brightness or depth of color in the HB strains.

METHODS OF BREEDING TO MAINTAIN AND IMPROVE THE STRAIN

	#1	#2	#3	#4	#5	#6	#7
INBREEDING	x	x*			x	x	x
Sibling cross	x	x*			x	x	x
Father to daughter		x*			x		
Mother to son							
LINE BREEDING		x	x		x	x	x***
No. of lines kept		6*			2	2	
Crossed after how many generations		4	3		4	?	4***
OUTCROSS				x			
Cross to different body color or pattern				x**			

* Inbred for 4 generations then line bred, 2 strains are crossed every 4th generation. The other four are crossed at will. Sometimes a cross doesn't work, so I flush and make a cross into another line.

** The highest percentage of light blue iridescent tails has been obtained by outcrossing to a gray-bodied, dark blue caudal strain. Don't ask me why, I just tried it on a hunch and it worked.

*** Backcross to females of the pure green line after 4 generations.

Once the original outcrosses are made that start giving a certain percentage of the desired color, the almost unanimous method of setting the pattern into a pure strain is by inbreeding and line breeding. The main difference between working the blues, as in Section 1, and the HB is that the blues are already well established strains, whereas many of these HB strains are newly developed and are still in the process of being set. They are mostly not as true-breeding as the better established blues, hence careful selective breeding is imperative, but should become more and more predictable as generation after generation of selective line breeding or inbreeding eliminates the majority of undesired color variations and sets the desired color.

Strain #4 indicates an approach which should not be overlooked...continually breeding fish of the desired color into another compatible strain. If the same secondary strain is used throughout, this process eventually becomes quite similar to line breeding, as with each generation the desired strain becomes more closely related to the secondary strain, even though the secondary strain is being maintained in a pure state. There are times when method can produce results much more quickly and successfully than by inbreeding or inbreeding alone. #7 is using the same principle but only after every fourth generation instead of with each generation.

METHODS OF BREEDING SHOW FISH FROM THESE HALF BLACK STRAINS

Basically, the techniques of producing show fish from these HB strains were listed as virtually the same as techniques used to produce breeders and for maintaining or improving the strain. The few additional comments are listed below:

#2 Two lines are sibling crossed. With 4 lines I breed at random, males to females from any line and I feel results are good, at which time I cross for 4 generations then line cross.

#4 Best results for all purposes are obtained when HB breeders are bred through grey-bodied fish of a different blue strain.

#6 Line breeding works best for improving quality of the fish, sib crosses are best for maintaining the strain.

#7 I continue to backcross into females of the pure green strain every 4th generation to improve quality.

OUTCROSSING AND THE EFFECTS ON COLOR

#1 No outcrosses listed

#2 HB male bred to red female gave all red males and all HB females. Fair results but did not pursue further. Am now using the HB females from that cross into my line 5 HB red males

#3 Bred to red and got golden yellow caudals. Bred to green and got good pastel greens, some with spotted patterns

#4 Bred to blue results the best of all. Breed the HBs through this color regularly

#5 No outcrosses listed

#6 Got good results when crossed with either greens or blues

#7 Good results when crossing into the greens. Back cross the HBs into this color strain regularly about every 4th generation. This strain seems to cross well into any other strain of guppies. At least once a year, one spawn will have HB Golds. They are not worth maintaining but are fun to back cross with

Since most of these strains are relatively new, it is not surprising that experimental outcrosses have not been undertaken often. In establishing a new strain, the most important object ive is to set the desired color. Out- crosses frequently increase the color contaminants and would therefore tend to make it more difficult to set the color.

It should be becoming increasingly obvious that not all HB patterns are passed on the same way. Some are passed through the males, as for example #7, which gives half black males when crossed to grey-bodied females.) When carried by the male on the male Y-chromosome, the trait is passed on to his sons but not to his daughters. Other HB patterns are passed on via the female X-chromosome (example strain # which gave all red males when crossed to a non-half black, but the HB sire passed the trait through his daughters who are the only offspring to receive his HB loaded X-chromosome. They, of course, can now return the trait to the male side by passing it on to at least part of their sons.) Still other HB strains combine both kinds and all males and females of an F-1 outcross to a grey-bodied strain will show the HB (the F-2 is a different story, which is best gone into in more elaborate genetic articles.)

Needless to say, when working with a half black strain, it can be of tremendous help in setting up a breeding program to know with which form of HB you are working. If in doubt, cross one of the HB. males to any grey-bodied female. If F-1 males are HB and their sisters are grey-bodied, the HB pattern is being passed on the male's Y-chromosome to his sons only. If F-1 males are grey-bodied and their sisters show the HB. then you are dealing with a HB that is being carried on the female X-chromosome (remember, the male carries one X and one Y while the female carries only 2 X-chromosomes). If both males and females of the F-1 show half black, it can be assumed that the trait is being carried on both the Female X and the Male Y. (the results of someone having crossed the two types somewhere along the line.)

There are additional complicating factors which affect the depth of the half black coloration and the extent of the black coloration (known as modifiers to the genetics buff) but here again, the explanation is far deeper into the field of genetics than is meant to be covered by this series.

IF ALL OF THE STRAIN WERE LOST EXCEPT ONE MALE...WHAT WOULD YOU CONSIDER TO BE THE BEST OUTCROSS TO PRESERVE TUE COLOR?

#1 Blue/greens because it is one of the strains in the background. Would expect about 40% black orchids.

#2 Red females. Would expect red males and HB females in the F-1.

#3 To a Zesch green female because males are dominant as far as the HB is concerned. Would expect HB green and Hb pastel in the F-1.

#4 Dark Blue female because it seems to improve color in caudals. Would expect 25% desired color caudals, rest would be impure with red mixed in.

#5 Another pastel strain.

#6 Blue females...based on past results.

#7 Green females, same as in the original cross. Would expect excellent results.

In all cases the outcross preferred would be to a female carrying the same or at least similar caudal color. It is interesting to note that none of the seven breeders suggested outcrossing to another HB strain, but preferred grey-bodied females for the outcross. No doubt this is partly because grey-bodied females from well-established pure strains are so much more predictable color-wise than the more newly developed HB strain females. After hard work purifying the desired caudal color of a new strain, few breeders would want to throw in any unnecessary color contaminants.

GOALS, PICKING BREEDERS AND FRY EXPECTATIONS

GOALS:

#1 To set a strain to produce large 3/4 black bodied males with solid and variegated purple caudals and dorsals.

#2 The biggest and best HBs that can win the International Class Championship. To make the females more prolific and produce larger bodied male.

#3 Although I am now only maintaining the line and not working as I was working for high greens and yellow half blacks.

#4 A reasonably true-breeding strain with high blue-iridescent caudals and dorsals.

#5 Bigger caudals with some that are yellow. Would like to win the Class Championship with her.

#6 My goal is a strain that can be used to improve any strain except the swordtail - not to win trophies.

#7 To work the black spots from the caudal and dorsal, to have HB whites.

Now, with these goals setting the breeding criteria, let's see how the various breeders go about selecting the breeding stock that hopefully will carry them toward their goal.

SELECTING FEMALE BREEDERS

#1 I look for size, body color, caudal color, body shape, dorsal shape and tail shape - in that order being especially careful that there is no green in the female color.

#2 I use young females at such an early age that I select them at random.

#3 I look for females with the clearest tails, long, wide dorsals, and as close to delta shape caudals as possible. I do not consider body color important, but have found that those clearer tailed females throw the best young.

#4 I look for 2 1/2" to 3" body size in my breeder females. The body color should be black and the caudal color light, powder blue. I prefer a high caudal with a good spread. Body shape, C/R ratio, dorsal shape and caudal size are also considered.

#5: My females are bred too young for me to be very selective

#6: My female breeders are selected on the basis of body shape and caudal shape primarily

#7: I look for a thick peduncle, short, squat body, and black tail. Of course, size, caudal shape and size and good dorsal characteristics are also watched for

TRAITS LOOKED FOR IN FEMALE BREEDERS

	#1	#2	#3	#4	#5	#6	#7
C/R ratio				x			x
Body size	1*			x		x	x
Body shape	4		x	x			x
Body color	2			x			x
Caudal size			x	x			x
Caudal shape	6		x	x		x	x
Caudal color	3		x	x			x
Dorsal shape	5		x	x			x

*listed in order of importance

In breeding the blues we found that the trait most often looked for in the selection of female breeders was caudal color. In selecting females for these HB strains the preference has swung to caudal shape, with all the breeders who are selective about females looking for this characteristic. Perhaps one reason for this is the outstanding quality of the females of HB strain often carry - many can put a mate to shame with their flowing caudal fin cape. Next in order of importance are body size, body shape, caudal color and dorsal shape - with the other characteristics falling into line behind.

SELECTING MALE BREEDERS

#1: I look for size, caudal color, caudal shape, dorsal color, dorsal shape, body color, and body shape in that order. It is important that there be no green in the males.

#2: I look for size, body color, caudal color, dorsal color, caudal shape and size.

#3: I select males with large bodies, intense HB color and normal body shape. The tail should be a good delta with light green or golden yellow color. The dorsal should be a 3/4 ratio and match the caudal in color.

#4: I look for a body of good size and shape that has good black color. Delta caudals with light blue color are selected and dorsal color should be the same light blue and a good shape. I use the IBGA standards when selecting males.

#5: I look first for body size, caudal size and color and dorsal color. Next to be considered are caudal and dorsal shape and body color.

#6: In my male breeders I look for body size, color and shape followed by overall proportions.

#7: In selecting male breeders I consider body size, shape and color...caudal size, shape and color...and dorsal size, shape and color. In selecting for color I breed for less black spotting.

TRAITS LOOKED FOR IN BREEDER MALES

	#1	#2	#3	#4	#5	#6	#7
Body size	1*	x	x	x	1**	x	x
Body shape	4		x	x		x	x
Body color	6	x	x	x	2	x	x
Caudal size	3	x	x	x	1		x
Caudal shape	3	x	x	x	2		x
Caudal color	2	x	x	x	1		x
Dorsal size	5		x	x	2		x
Dorsal shape	5		x	x	2		x
Dorsal color	4	x	x	x	1		x
Other				x		x	

*listed in order of importance

** 1= primary concern, 2=secondary concern

The unanimous traits looked for by all the breeders when selecting breeder stock for these HB strains are body size and body color. The number of breeders who listed all the features as being considered indicates that really would like all of them to be as good as possible. However, fish don't always cooperate by being above average in all these categories, so decisions must be made as to which factors are the most important. This of course, would depend to some degree on your goal - the above listing may help by indicating what other breeders consider to be the most important with their HB strains.

BREEDING AGES, SIZE OF LITTES, RATIO OF MALES TO FEMALES

	Age bred males	Age bred females	Average litter size	ratio males/females
#1	3-5 mo.	3-5 mo.	40-70*	50/50
#2	4-8 mo.	6-3 weeks!	20-35	50/50
#3	5 mo.	5 mo.	50	50/50
#4	5 mo.	6 wks. to 3 mo.	50	50/50
#5	4-5 mo.	2 mo.	25-40	50/50
#6	3 mo.	3-5 mo.	10-50	50/50
#7	3-4 mo.	3-4 mo.	30	50/50

*some over 150

Apparently with the more newly developed HB strains, the ratio of males to females in the fry remains the expected 1:1 on the average. However, it is interesting to note that in the 3-year pure strain #6, the same problem of uneven ratios of males and females pops up as it did in some of the long pure blue strains.

GENETIC TRAITS BELIEVED CARRIED BY THE DIFFERENT SEXES

	#1	#2	#3	#4	#5	#6	#7
Body size	?	?	M	?	?	F	F
Body shape	?	?	M	?	?	F	F
Dorsal size	?	?	F	?	?	M	M
Dorsal shape	?	?	M	?	?	M	M
Dorsal color	?	?	M	?	?	M	M
Caudal size	?	?	F	?	?	M	both
Caudal width	?	?	F	?	?	F	F
Caudal color	?	?	M	?	?	?	M

Bear in mind when reviewing these charts, that these breeders make no claims to being scientists. They are merely reporting what they believe to be true after working with their strains over the years. There is, however, a great deal of similarity between them. All those reporting attributed caudal width to the female and dorsal shape and color to the male side of the matings. The only two reporting on caudal color both put that on the male side also. Again, the figures are far too skimpy for any sort of final proof, but by the end of this series perhaps some meaningful trends will appear which can be passed on to newcomers with breeding problems.

FAVORED ENVIRONMENTS FOR KEEPING THESE HB STRAINS

	Use of salt	Special diet	Special environment	Hormones used
#1	1 tsp/5 gal.	no	no	never
#2	1 tbsp/5 gal.	no	no	never
#3	Treating only*	no	no	never**
#4	1 tbsp/5 gal.	no	no	never on males often on females***
#5	1 tbsp/5 gal.	no	no	never
#6	*	no	no	never
#7	none	no	no	never

*see qualifiers

* Only use salt for treating fish. Constant use defeats the purpose of salt or other medications

** Hormones cause too many junk fish to get on the market so too many people spend money for sterile fish or fish that don't breed true

***Use methyl testosterone to color test for breeding. Begin treating at three months of age. Results: no difference in size. Color intensifies with increased iridescence. The right blue iridescence is what I am looking for in breeders. Body color is HB and the dorsal shows light blue. Both tail & dorsal become very large. Some females do become sterile.

GENERAL PROBLEMS

#1. To combat color impurities we select fish that show only the desired purple

#2. Not as prolific as I would like. I have to breed females at a very early age, 6-8 weeks.

#3. To keep spots out of the tail. Combat by culling out undesirable traits and continuing from here. No other real problems as long as the fish are cared for properly, although they do get an occasional bent spine.

#4. Color impurities. Method used to overcome this so far has been outcrossing to a solid color strain.

#5. Color impurities. Use the purest yellow tails for breeding.

#6. Flecked color in some strains. Do not use these for breeding.

#7. At least once a year one spawn will have HB Golds. Not worth maintaining but fun to back cross with.

The main problems with these halfblack strains seem to be color impurity problems, probably because most of the strains are too new to have been set for the desired color, but even a well established strain will usually have a percentage with color impurities.

COMMENTS BY BREEDERS

#1. We originated this strain, which first showed up in the above named crosses about 4 1/2 years ago.

#2. I attribute my success not to knowledge but to hard work. 9 feedings a day with a wide variety of foods. 75% water changes a day.

#3. Maximum caudal size develops slowly. Frequently males have an iridescent marking in the head and body ranging from white to pale green.

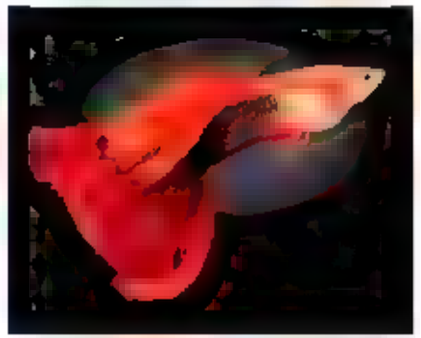
#4. Would like to know if anyone with such a similar [illegible] these who might be willing to swap. I feel an outcross to the same color is what I need at this point.

#5. Heavy feeding and frequent water changes make for success with these fish.

#7. This strain seems to cross well into any Hunter strain of guppies.

And there we have the Half Blacks. If it is too big they could not have been broken down by caudal color, but these are now so varied that it would take a year to cover the HBs alone if all colors were taken separately. However, the breeding problems listed seem to be common to most HB strains.

From Guppy Roundabout, Jan. '82



FISH ROOM TIPS

By Joe Scandone

DO YOU HAVE TROUBLE CLEANING GREEN ALGAE FROM A ROUGH BOTTOM TANK Try a stiff bristled scrub brush it works nicely and fast

2. IS IT A HASSLE TO FIGURE THE AMOUNT OF SALT TO REPLACE AFTER SYPHONING TANKS? Make use of your aged water barrels and add the salt to them and replace the syphoned water from them, Presto Instant correct salt content

3. DO THE COLORS OF YOUR FISH ALWAYS SEEM WASHED OUT" Paint the bottom of your tanks black Your fish will take on a deeper and richer color in time

4. DON'T BE AFRAID TO ADD AN ADDITIONAL TABLESPOON OF EPSOM SALT TO THE HATCHING BRINE SHRIMP I have found that it helps tremendously towards better hatches

5. IT APPEARS THAT THE HARDER THE AGITATION OF BRINE SHRIMP EGGS, THE BETTER THE PERCENTAGES OF HATCHES YOU'LL GET

6. HAVING TROUBLE WITH AGED WATER BARRELS ALWAYS IN THE WAY? Do they take up wall space needed for more tanks? Try using them for your work table Place them where you want your work table and place a piece of plywood on top. Presto, you now have a work table

7. HERE'S A NEW SLANT ON REPAIRING A LEAKY TANK Put the tank in the bathtub, fill with hot water let set for 10 minutes, drain tub with hot water let set for 10 minutes, drain tub, let set for 30 minutes, drain and refill with cold water This will fix many stubborn leaks indeed. note: this may be for the old black slate bottom tanks

8. INSTANT IDENTIFICATION OF DIFFERENT STRAINS OF FISH Number each strain make a master list of what each number means, Use a felt tip marker to write on tanks it can be removed easily If you cross one strain to another label it as such (1x3 or 1x3b, etc.).

9. DO YOU STARTLE YOUR FISH WHEN YOU FIRST TURN ON THEIR LIGHTS IN THE MORNING? Use a small night light, leave it on all night The fish will still sleep but won't startle so easily when you turn on the brighter lights

SWORDTAIL CONTROVERSY...Larr - appendix

EVALUATION OF TOP AND BOTTOM SWORDTAILS

The following charts represent only about 10% of the crossing that was done to evaluate top and bottom swordtails from some very well-established strains. The results were disappointing. We were hunting for an X or Y linked trait because of the tremendous importance they are to further study of other traits. We didn't find any anywhere. I submit these figures to show my point and show the techniques used. The charts below are, of course, mainly aimed at Y-chromosomal work. The X-chromosome studies simply take a great deal more paper and they all said exactly the same thing

CHART 1

SIBLING CROSSES WITHIN SIX SWORDTAIL STRAINS

Although the number of pairs of each strain tested is indicated on the chart, the results shown are from just one pair of each strain Duplicated work on the other pairs would be repetitious as the results were very comparable. These were very well established strains in which a high percentage of the males bred true to type. Please note that #1 and #4 represent breeding records of original Wingé swordtail strains

	Strain	Type of cross	Pairs tested	Total males	Top Swords	Bot. Swords	Round tails
#1	Wingé Topsword A-211	sib	5	406	344		62
#2	Topsword A-482	sib	5	417	402		15
#3	Topsword A-522	sib	5	467	409		53
#4	Wingé Bottomsword A-3	sib	5	437	15	422	
#5	Borromsword AA-16	sib	8	433		411	22
#6	Bottomsword AB-22	sib	8	455		407	48

CHART 2

OUTCROSSING BETWEEN SWORDTAIL STRAINS

This series of tests shows a simple outcross between two of the above strains, #2 and #4 done both ways (male of each strain x female of opposite strain). Had the traits been X or Y linked we would have had quite a different set of results (further tests were made beyond this to prove the point

Outcross	#2 male x #4 female	#4 male x #2 female
Total Males	522	509
Tail types produced		
Topsword	217	244
Bottomsword	122	63
Doubleword	70	28
Roundtail	113	174

CHART 3

OUTCROSS OF SWORDTAIL STRAINS TO NON-SWORD STRAIN

In the outcrossing of the swordtail strains to strains that had no swordtail characteristics, I think the results are self explanatory. I might mention that the figures on the plain male x #4 female looked very promising at first and I thought we might have something, but subsequent tests again showed that this was not a sex-linked characteristic.

Topsword x non-sword

Outcross	#2 male x plain female	Plain male x #2 female
Total males	473	440
Tail types produced		
Topsword	49	62
Roundtail	284	212
Other	140	166

Bottomsword x non-sword

Outcross	#4 male x plain female	Plain male x #4 female
Total males	561	418
Tail types produced		
Bottomsword	184	92
Roundtail	212	215
Other	165	111

CHART 4

BREEDING RECORDS OF A Y-LINKED CHARACTER

To illustrate what I mean by a sex-linked character I have put in here the study of the Tangential Eye Line, a trait that is located on the Y- chromosome. The results are completely explanatory and illustrate very clearly the type of results that are obtained when a character is Y-linked. This particular trait shows up in a great many of our modern guppies and you can reproduce it any time if you happen to want a tangential eye line on your guppies.

Tangential eye line - a Y-linked gene

Cross	Total males	Tangential eyeline	no Tangential eyeline
Male with T. eyeline x female from non-T. strain	423	423	-0-
Male without T. eyeline x female whose brothers all show the T. eyeline	462	-0-	462

AGP PANEL - SECTION 3

Third article in the Advanced Guppyist Panel Series on "Techniques of Breeding Specific Guppy Varieties.

ADVANCED GUPPYIST PANEL

Section 3 - BREEDING THE SWORDTAILS

Compiled by Midge Hill ©Whittier Calif 1972

It seemed appropriate in this special swordtail issue to include the AGP Panel reports on swordtails. Again our thanks to all the breeders throughout the world that have made this series possible.

AGP CHARTER MEMBERS

Ron & Tina Ahlers	Bob Bichner	Malcolm Dellingpole
Ed Driscoll	Midge Hill	Bob Isele
Charlie Koepke	Tad Kusak	Dr. Eugene Larr
Dale Matheny	Dr. Clyde Marx	Bob Maxwel
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Don Sauers	Joe Scialoone	Stan Shuba
Dr. Wm. Snow	Mel Socha	Jim Thara
Louis Wasserman	Jack Wilson	Yeo Buk Kang

Section 3 - Breeding the Swordtails

SWORDTAIL STRAINS REPRESENTED:

#1 - Viennese Green Lower swords (pure strain from Vienna, maintained pure for 3-4 years) - Malcolm Dellingpole

#2 - Busovickie swords (pure strain dates back to at least 1960. Ran pure and also outcrossed) - Don Sauers)

FEATURES OF THE STRAINS AS COMPARED TO AVERAGE (Blank Space = Average)

	#1	#2
Size	smaller	smaller
Vigor	stronger	stronger
Dorsal	longer	longer
Rate of Growth	slower	slower
Rate of Maturity	earlier	later
Fertility	more fertile	more fertile
Cannibalism	less	less
Susceptibility to disease	less, also less deformities	long-lived

It is interesting to note that even though these two swordtail strains are from different continents they are almost identical in all features, the only difference being that #1 matures earlier than does #2. Can this be chance, or is it indicative of swordtail strains in general?

We cannot tell from this small sampling but the similarities can be watched for when working with other swordtail strains.

It would seem that there is irregularity in the breeding patterns of even the purest-bred swordtail strains, particularly as to the type of sword tail. The lower swordtail strain #1 throws occasional doubleswords. Strain #2 produces about 30% bottomswords and 20% doubleswords. (See the preceding section on swordtail genetics to learn more about the whys and wherefores of this.)

strain	time kept pure	siblings	% of impurities	% of desired color	% different color
#1	3-4 yrs.	somewhat varied*	30%**	70%	-0-
#2	?	Fairly uniform***	-0-	70%	30%****

* Occasional doubleswords, some clear swords, some with black in sword

** Lack of black in sword, lack of pattern in dorsal

*** 40% bottomswords, 20% doubleswords of inferior quality

**** Some had red or orange swords, others had green swords

There seems to be considerable linkage between different factors when working with swordtail strains as evidenced by the following information given by these two breeders

Strain #1: Size seems linked to quality of the sword. About 99% are small bodied. The occasional big-bodied fish does not have the long dorsal or sword. Also a feathery dorsal seems linked to the color pattern of the dorsal. If the dorsal has a color pattern (black and/or green) the dorsal tends to be heavy and feathery.

Strain #2: Color and shape seem linked in this strain as the fish with blue-green colored swords consistently has better shape than those with other colored swords. For some reason dorsal fins that have a slight orange cast seem to be larger. Though this strain produces good sharp swords, the double swords are generally inferior in quality to their bottomsword siblings.

METHODS OF BREEDING TO MAINTAIN AND IMPROVE THE STRAIN

	#1	#2
INBREEDING		
Sibling cross	x	x
Father/daughter		x
Mother/son		x
OTHER		x*

*About once a year cross a delta female of the desired color and keep only females to be bred back to pure sword male. I prefer females with clear tails.

In both cases these breeders use the same breeding methods to produce their show fish as they use for maintaining and improving the strain. In no case was an outcross to a different swordtail strain mentioned as a way to improve quality, and although #2 crosses into delta stock periodically, the mixes resulting from the outcross are not used for breeding.

Since the selection of breeders is closely tied in with goals toward which the strain is being worked, the goals will be considered as a vital part in the selection of breeders.

#1 - Goal: to improve body size while retaining shape and color concentration. Also to increase caudal and dorsal length while retaining single points at the end of each.

#2 - Goal: To develop a doublesword guppy that can win best of show

Traits Looked for in Female Breeders

	#1	#2
C/R ratio		
Body size	medium	yes
Body shape		yes
Body color	clear	
Caudal size		
Caudal shape	round	
Caudal color	clear	must be clear
Dorsal size		
Dorsal shape	round	
Dorsal color		

Regarding the goal both breeders are emphatic that females selected to maintain or improve their strains should have clear tails. #1 prefers the entire female to be as free from pigmentation as possible and also looks for round fins.

Traits Looked for in Male Breeders

	#1	#2
Body size	large	large
Body shape	to IFGA standards	yes
Body color	green & black	green
Caudal size	long, equal to body length	yes
Caudal shape	taper to single points	pointed swords
Caudal color	green & black	
Dorsal size	extends well beyond the caudal peduncle	
Dorsal shape	tapers to single point	yes
Dorsal color	green & black	green
Other	yes	yes

On the selection of male breeders, it can be seen that both breeders are utilizing the linkages they have found between color and quality. Both select males with the colorations that consistently throw the best swordtail young. It is interesting to note that in both cases green coloration is looked for, even though both strains produce fish with different colors. Is this because these two breeders are partial to green...or is it because they have discovered that better quality sword tails are produced by breeders carrying green coloration? This might be worth checking out with other swordtail strains.

OTHER POINTS CONSIDERED WHEN SELECTING BREEDER MALES

#1 always picks a long swordtail male with a single point and preferably without a feathery dorsal but one with some black as well as green in both dorsal and caudal fins.

#2 Use only the best colored males to breed.

BREEDING AGES, SIZE OF LITTERS, RATIO OF MALES TO FEMALES

	Age bred		Average	Ratio
strain	males	females	litter size	males/females
#1	6 mo.	6 mo.	40	50/50
#2	6 mo.*	before 4 mo.	35-40	50/50

* males must be almost a year old to show, but live to be 2 years old.

GENETIC TRAITS BELIEVED CARRIED BY THE DIFFERENT SEXES

#1 The female seems to carry body shape dorsal color and caudal color. (no other traits mentioned)

#2 (No traits mentioned)

IF ALL OF THE STRAIN WERE LOST EXCEPT ONE LONE MALE.. WHAT WOULD EACH BREEDER CONSIDER TO BE THE BEST OUTCROSS TO CARRY ON THE STRAIN?

#1 A clear round-tailed female...it's would throw either double or bottomsword males. I would expect a swordtail of sorts in the F-1

#2 A large green or metallic female these fish carry the color-factor plus large size. Some swords might be expected in the F-1 but would breed the F-1 females back to their father

Since #2 already does an occasional cross out to a large-bodied delta strain, it is not surprising that he would do so when faced with a forced outcross situation. Note again that the the females of the F-1 generation are bred back to the swordtail strain and that the male fry are not used for perpetrating the strain

#1 sticks with the clear round-tailed female probably from a different swordtail strain. Since the crossing of different swordtail strains has not been mentioned it would be interesting to know what happens to the quality of the swords when two strains are crossed

THE EFFECTS OF OUTCROSSING TO A DIFFERENT COLOR & TYPE

Both breeders report on only one such outcross. In both cases to a red delta

#1 Outcross to red delta. Results. Red color was added to the green and black on the body. Still waiting to see how size is affected.

#2 Outcross to red delta male accidental. Result. One fish from the litter thrown by the swordtail female x the red delta male won me 8 trophies. (He does not state what type of tail the fish had).

FAVORED ENVIRONMENTS FOR KEEPING THESE SWORDTAIL STRAINS

Neither breeder uses salt in their water for these strains. They also do not give these strains any specialized diet or special environmental factors. Hormones are never used by either breeder on these strains, nor does either breeder use any chemicals, foods or additives that they have found to enhance color in swordtails

From Guppy Roundtable July 1972

THE VALUE OF FEMALES IN BREEDING *by, Warren B. Young*

During the years in the tropical fish hobby, I am amazed in the lack of articles and information about, to me, the most important fish that we have in our fishrooms, namely the female of the species. Without her, things would be somewhat dull. For some unknown reason, the average hobbyist regards the female as a necessity that is needed to bear young fry and they have no control at all, as to what the next generation will be like.

The female has a lot to about the size and finnage of your next generation and also a good deal about color. Now that we have said it, let's go about proving it. To do this, let us first go to the fish that has done more to enlighten the hobbyist about the value of the female than any other fish the guppy.

The majority of good guppy breeders do their breeding by trios a combination of one male and two females. The idea is to find out what combination is producing the fish he is after. I usually mark my females by cutting the top of one tail and the bottom of the other. These fry will be kept in seperate tanks, marked in this way. In two or three months we can tell if we have anything worth keeping. If we have a good pair we discard the other female and its fry and try another female until we get what we want, using three or four breeding tanks or any amount you have room for. It won't be long before you are producing good fish. Never ask a guppy breeder to sell you his breeding stock, because you are then risking the chance of being shown the door in a hurry.

The question always arises that, if you go through all this trouble why don't all your females throw good fish in following generations, it is true that the better a line is set, the better your chances are for having a larger amount of good females, but for some unknown reason, to me, fish will go backwards toward their original state much faster than they go forward. So, it is always a battle to find the right females.

I am sure that you all know of cases of people who have produced good fish for one or two years and then seem to lose everything and by their inability to find, or take the time to find pairs or trios that will produce the fish that they originally had.

Those of you that were in the hobby before the fish world went crazy about the delta tail guppy know the amount of females and young fry that were discarded in the search for the pair that would give us the angle on the caudal that would put the guppy in the delta tail class.

I often ask people who have come to our fish room why they want a trio instead of a pair and, by far, the answer is always because they will get more fish by using two females instead of one. I have stopped trying to explain why a breeder uses a trio.

The same thing is happening with our Betta breeders. As long, as they can get a pair to breed, they will keep on breeding them no matter what kind of young they are producing. The only outcome of this type of breeding is a room full of Bettas and not a show Betta in the lot. The best thing to do is to get rid of the lot and start all over again. Our method is to pick three females from a particular batch and take the best male we have, and every 14 days breed him to one of the females. By keeping each batch seperate, we soon determine what pair is producing the best and we discard the others, and breed with the one pair.

Many of you are wondering at what age we start our fish breeding. We have experienced that the younger better. As a general rule we start them at four months of age. By then, you know what they will be like when full grown and all that is needed is proper care and feeding. Then, no judge could pass by without a second look.

This method of breeding can be carried out with most any type of fish and is much better than community-breeding. In community breeding, you cannot determine where the good fish are coming from.

You have to have patience, work a little harder, and keep records, but the satisfaction you will get from seeing tanks or jars of good fish is well worth the effort. •

Reprint The Glades Oct. '79

GUPPY GENETICS

PART I - INTRODUCTORY TERMS

by Jack Rosengarten, PPG4

After the recent series of articles concerning swordtail guppies, I found myself both agreeing and disagreeing with all concerned as I recalled my own experiences and impressions. It quickly became apparent that my knowledge on the subject, gained entirely from a High School Biology course, was sadly incomplete. Finally I went to the library to fill in the obvious gaps. For those of you similarly motivated, I suggest books which deal with Heredity rather than pure Genetics.

The current genetics books are of little value to the breeder as they deal with the molecular structure of genes at a level only a biochemist could understand.

To save you some trouble or perhaps to further stimulate your interest, I've decided to write a series of articles to try to explain genetics as it relates to guppies. Since the two books I read do not mention guppies or even fish, I had to use my own judgment in selecting characteristics which might apply to guppies. Therefore, any comments about guppies are entirely my own opinion or those of others that I respect. A companion article to this will invite your participation to supply examples of guppy genetics. The literature deals mainly with the fruit fly (Drosophila Melanogaster) and humans, citing other animals to illustrate particular characteristics so that I may be forced to likewise go to these examples.

This article deals mainly with the basic definitions which I hope will not be too repetitious for most of you, but they will assure that the following articles can be understood. Some of the definitions will require extensive examples so they will be left for future articles.

NOW FOR SOME VERY BASIC DEFINITIONS:

GENE: To the breeder this is the smallest unit of inheritance although the geneticist now subdivides this to attempt to explain why genes are different and how they function. We will adhere strictly to what is useful to the breeder.

CHROMOSOMES: All genes are located on thread-like bodies called chromosomes. These are normally found in pairs. The nucleus of every cell contains a set of chromosomes. The fruit fly has eight chromosomes, while humans and guppies have 46 chromosomes (are we related? It is estimated that humans have as many as 30000 genes, so guppies probably have a comparable number. If that seems like a lot, remember that every physical characteristic is determined by at least one gene.

ALLELES: Genes which occupy a specific location on a chromosome usually control a specific trait. Variations of this gene are called alleles, and they can cause corresponding variations in the trait. Since the chromosomes come in pairs, the genes will likewise come in pairs and whether they are both the same or different is really the backbone of heredity.

POLYGENES: Frequently a characteristic is influenced by more than one pair of genes. This group of genes are known as polygenes or multiple genes. Obviously breeding gets more complicated when polygenes are involved.

GENOTYPE: This is the description of the genetic makeup of an organism usually described symbolically with letters.

PHENOTYPE: This is the appearance of the organism caused by the genetic makeup. Individuals with different genotypes may still have the same phenotype, or appear to be the same.

HOMOZYGOUS and HETEROZYGOUS: As mentioned earlier, genes usually come in pairs. If both genes of the pair are the same, the organism is said to be homozygous. If both genes are different, the organism is known as heterozygous.

DOMINANT or RECESSIVE: The relative importance of each allele is classified as dominant or recessive to each other allele. Possession of one dominant allele is sufficient to establish the dominant phenotype. The heterozygous organism will look identical to the organism that is homozygous for the dominant gene. Both identical recessive genes are needed to express the recessive phenotype, unless of course, the odd gene is a third allele that is even more recessive. There can also be an intermediate expression where the heterozygous organism is a different phenotype than either of the homozygous genotypes (in other words, three different appearances result from the various combinations of two different genes). Geneticists use capital letters to denote dominant genes and small letters to symbolize recessive genes (i.e. genotypes for brown eyes could therefore be written as BB, Bb or bb where B is a dominant gene for brown eyes and b is a gene for a recessive trait that is not brown eyes. Multiple alleles are written as letters with various superscripts.

NOW THAT YOU KNOW THE BASICS, LET'S PROGRESS INTO HOW THESE TRAITS ARE PASSED ON TO THE OFFSPRING

MEIOSIS: This is the process by which cells with a normal number of chromosomes divide to form the sex cells (eggs or sperms) necessary for fertilization. This division separates each chromosome pair so that each sex cell has only half the normal number of chromosomes. When they join during fertilization, the number of chromosomes will again be correct. It is a pure game of chance as to which of each chromosome pair is in each egg or sperm, but all of the genes on each chromosome will move as a unit (with some exceptions).

SEX DETERMINATION: As mentioned earlier, chromosomes occur in pairs. Excluding abnormal cells, these pairs are usually matched in size and in approximate appearance. The normal exception to this rule are the pair of chromosomes that determine sex. In humans, fruit flies and guppies, the male has a pair of chromosomes differing greatly in size. The smaller of the pair is designated as the Y-chromosome and the larger is designated as the X-chromosome. The female, in contrast, has a pair of X-chromosomes. These chromosomes are inherited the same as all the others so that an individual with an XY chromosome pair is male and one with XX chromosome is a female. This subject is not quite that simple. I'll leave that explanation for a later date.

SEX-LINKED GENES: Genes located exclusively on the X-chromosome are called sex-linked genes since their inheritance is related to sex determination. In the hobby this is usually referred to as **X-linked** and I'll stick with that usage. A good sample of the characteristic are some of the half-black strains of guppy.

HOLANDRIC GENES: This term applies to genes located exclusively on the Y-chromosome or **Y-linked**. Few genes appear to be located on the chromosome so that this condition is relatively rare. Examples of this in guppies are also certain half-black strains, snake skins and also the tangential eye-line.

AUTOSOMAL GENES: This covers all genes located on the other chromosomes. Their pattern of transmission is therefore independent of sex determination.

INCOMPLETELY SEX-LINKED GENES: Genes in this category have alleles on both the X and Y chromosomes so that they behave like autosomal genes but their pattern of transmission shows their relation to sex determination. I don't know of any guppies that fit this pattern but certainly the half-black strains mentioned above are candidates if they are indeed alleles. I think some of the swordtail guppies

are also possible candidates but I'm now convinced that the double-swords that I have are caused by a dominant autosomal gene. It should be obvious that outcrosses of this type of gene with other strains will cause some confusing results.

SEX-LIMITED GENES: These are genes which maybe present in either sex but are expressed in only one sex. Certainly this must apply to the color and other secondary sexual characteristics of the male guppy. Female guppies treated with male hormones will color like the males and start to acquire male characteristics proving that the females have the genes to make this possible. Hormone treated females can even develop a gonopodium (male anal fin) although they will never be fertile males. In the fruit fly, only the genes for male fertility are located on the Y-chromosome and this appears to be the case with guppies.

SEX-INFLUENCED GENES: The class consists of genes which are dominant in one sex can be recessive in the other sex. The best example I can think of concerns the X-linked hemophilic gene in humans. In men only one gene is necessary (only one is possible) to cause hemophilia while a woman is an unaffected "carrier" of the gene. In contrast, a woman with two genes for hemophilia is herself a hemophiliac.

LINKED GENES: This term covers genes which govern different characteristics but are located on the same chromosome so that they are inherited together. Of course this is a great nuisance to a breeder who is trying to separate an undesirable trait from a desirable trait. I would guess that the small dorsals associated with snakeskins are an example of linked genes. The next two terms, however, offer some hope for the frustrated breeder. It should be pointed out that if linked genes govern the same trait the breeder will be obvious of the fact and assume that there is only one gene involved.

CROSSOVER: An extremely unpredictable phenomenon which occurs is that of crossover wherein linked genes are indeed separated. Somewhere in the formation of the gametes (a general term for eggs and sperms) a pair of chromosomes break and exchange halves. If the above example is true, someday a breeder maybe lucky enough to have a large dorsal gene on one chromosome and a snakeskin pattern on its companion when a crossover occurs. Since snakeskin is a Y-linked gene (although some claim there are also X-linked snakeskins) this would be a most unusual crossover and could result in sterile males if too much of the Y-chromosome is lost. Hopefully, if this fish turns up it will not be culled for some other reason before the crossover is noted.

MUTATION: In the strictest sense, this is the occurrence of a gene which was not observed. It maybe a gene that was altered with chemicals, radiation, heat or by accident. Whatever the reason, a new trait may show up and if desirable could lead to a whole new strain of guppies. The breeder, of course, will probably call anything that wasn't expected, a mutation, even though it may only be a recessive trait that has finally surfaced.

EPISTASIS AND MODIFIERS: Epistasis and modifiers I am probably ill advised to lump these together but on a basic level these genes alter or inhibit what other genes do. Thus they are autosomal modifiers of the half-black genes, which make the "black" even blacker. Sometimes one pair of genes within a group of polygenes will inhibit the function of the polygenes. A case in point is the polygene for pigmentation which is inhibited by a pair of albino genes.

In the next article, we will get into examples of how the traits are passed from parents to offspring and methods of optimizing the desired results. Please read the companion article which I have deliberately given a separate title in attempt to outwit those who decided to skip this article as too "familiar or complicated."

BREEDER REPORTS

by Jack Rosengarten

You may recall the series of articles that appeared in GR under the title "Progress Reports". Although this feature was well received, it was poorly reported. Several meetings ago, with little forethought, I offered to try to revive the series.

After rereading the series, I realized that there were several basic flaws that undermined the possibility of success. Primarily they required the setting of high goals and the submission of regular reports. Anyone who has set a goal that they believed at the outset might be impossible, has known the frustration of discovering that they were right. To be asked to admit a failure in print, must be embarrassing.

I therefore, have decided to turn the direction of that series into a collection of spot reports which may or may not have sequels. These articles will be carried under the banner "Breeder Reports". As my first genetics article implied, I will try to sustain a series of genetics articles dealing with actual guppies. In rereading my article, I note that I have already made several guesses and expressed ignorance in providing some examples, obviously I'm going to need help.

The main thrust of Breeder Reports will be to pinpoint and unravel the important, known genetic traits. For instance, what is the relationship between the grey, bronze, blue, gold and albino body colors? Which characteristics are governed by linked genes? How many genes are required for specific colorations? Are the color genes alleles? How many genes for large dorsals or caudals? I could go on, but I think you get the point.

GR therefore invites anyone who has made specific outcrosses between "pure" strains to report their results. Don't worry about your writing ability, that's what the editors are for. Just send us the facts and we'll do the rest.

Information should include the strains involved, whether an outcross was made in both directions, a good description of the parents' attributes; a good count of the F-1 young indicating which of the parental attributes appeared and in what quantities. Descriptions of any F-2 young (describe F-1 parents) and any backcrosses will also provide valuable insights. Perhaps I can deduce from your information just how many genes are involved.

There's also something for those of you who are raising only "pure" strains. Ho about providing an actual count of a group of fry so that we can see just how pure they are. We're not trying to embarrass anyone, culling is part of the game, but how about a count of the attributes before you cull. I was surprised to read in our AGP series, that strains that were established for several years were still only 80 to 90% pure.

This request for articles is not made without the hope of reward for the contributor. We are still offering a bond for the best article written by a corresponding member and, of course, one for the active members, so please write. Perhaps we can get a good controversy going like the sword/no sword case. Hey, I just realized that in my genetics article I started calling the double-sword controversy. May be that's because I've had double-swords for more than 20 years, but have never had a single-sword. (Now that ought to bring the letters). We will also accept profound statements without specific proof, if you are brave enough to stick your neck out.

One more thing. We've been soliciting questions for a questions and answers column, but nobody has written. Is there anybody out there? Do you have any specific genetics questions?

GUPPY GENETICS

PART II - MONOHYBRID CROSS

by Jack Rosengarten

Last month we covered the basic terms involved in genetics. The intention this month is to start illustrating these terms and to show what they mean to the breeder.

The simplest genetic case is that of the monohybrid cross. This involves one pair of genes which determine a particular physical characteristic, such as body color. Where variations (alleles) of this gene exist the appearance (phenotype) of the organism will depend upon which alleles are present (genotype) and their relative importance (dominant or recessive).

A good example of a monohybrid cross (mating) is that of a cross between guppies showing a bronze body color and the wild gray body color. Body color is the background color of the body scales which in many of the males is mostly covered by a color pattern but always shows around the male's head. Body color is much easier to observe in the female guppies since, with the exception of the half blacks, most of the females do not have color patterns on the body. Body colors are autosomal traits which is to say that they are not caused by genes located on the X or Y chromosomes. Bronze body color is characterized by a gold body mosaic appearance. Gray body color is the body color of most guppies and is the color of the wild guppies. Other guppy colors are albino, golden, blond, cream and blue.

Bronze body color is a recessive allele of the dominant gray body color so that a bronze guppy is a homozygous genotype (both genes the same). The genotype is symbolically written as bb. Note that two letters are used to denote that a pair of genes is involved. Note also that lower case letters are used to illustrate that the genes are recessive alleles.

Gray body color is a dominant allele so that a guppy which is phenotypically gray may be either a homozygous or heterozygous genotype. The genotypes respectively, are symbolically noted as BB and Bb. B is the notation for the dominant gray gene rather than G in order to relate the alleles by a common letter. If different letters were used it would become difficult to distinguish alleles in multiple gene discussions. The accepted practice is to derive the symbol from the recessive gene.

Now for an example of what all this means to the breeder. Let's suppose that you go to one of our fine guppy shows and purchase at the auction a beautiful male (or female) bronze guppy. On the way home you are filled with visions of founding a dynasty of bronze guppies. Upon arrival at home you discover your first problem - all you own are gray guppies, what to do?

Aside from the obvious that you should have purchased a pair of bronze guppies, the only recourse is to mate him to one of your gray guppies. When the babies arrive you discover your second problem - all the babies are gray. Have you lost the bronze color? Not at all. This is just a simple case of the gray being dominant and even though all the babies look gray, they are all carrying a bronze gene.

Before proceeding further, let's diagram the above. Remember that normal body cells have pairs of genes carried on pairs of chromosomes (known as the diploid number). During the formation (meiosis) of the gametes (eggs and sperms), these pairs are divided and each gamete receives only one (the haploid number) of the pair. With the union of the egg and sperm during fertilization the diploid number is again present. Each parent therefore contributes half of the babies genes. The gray gamete is then noted as B and the bronze gamete as b. Of course, if you are dealing with pure genotypes all of each parent's gametes will be the same. A series of squares is used to illustrate the possible combinations of the gametes.

Figure 1 is drawn for the above case. The top row shows the possible male gametes (in this case they are the same). The left column shows the possible female gametes (again the same). The squares contain the combinations within the fertilized cells. All the resulting genotypes are Bb which is the gray phenotype.

	b	b
B	Bb	Bb
B	Bb	Bb

B — dominant gray gene
b — recessive bronze gene
Bb — gray phenotype

Figure 1 - The P-1 Outcross

The parents are called the P-1 generation and the babies are called the F-1 or first filial generation. Now what does all this have to do with your bronze dynasty? It is obvious from the above that you can breed that bronze with every gray you own and never see another bronze so that your next step will have to be different.

You now have three types to work with - namely the grays, the one bronze and the hybrid F-1. Of course, using the pure grays will be of no help in establishing a bronze line so that leaves two choices. Looking ahead you can see that a cross between fish that both carry bronze genes will yield some bronze babies but is there an important difference between the two choices?

Let's look first at a sibling (brother-sister) cross of the F-1. The babies are the F-2 generation and subsequent descending sibling crosses would result in F-3, F-4, etc. **Figure 2** shows the squares for this case. The gametes are now different since the F-1 are hybrids. Assuming equal numbers of the gamete types and equal survival of the young (not always true), each of the four squares represents the genotypes of one-fourth of the young.

	B	b
B	BB	Bb
b	Bb	bb

Bb — gray phenotype
bb — bronze phenotype

Figure 2 - The F-1 Sibling Cross

This means that among 32 fry you can expect to find four male bronze and find four female bronze babies. Is this the best you can do? If that bronze male is no longer alive, the answer is yes. If he is alive, let's examine a backcross between the F-1 and the bronze P-1. Incidentally, there is no good designation for the resulting fry. One book used R- for the resulting generation, but it does not distinguish between the two possible backcrosses nor subsequent possible backcrosses. Most references just call it a "new" P- or outcross designations.

Figure 3 illustrates a backcross between the F- and the bronze P-1. The bronze gametes are in the top row and the hybrid gametes are in the left column.

	b	b
B	Bb	Bb
b	bb	bb

Bb Gray phenotype
bb Bronze phenotype

Figure 3 - F-1 x P-1 (Backcross)

As you can see, two-fourths or half of the fry are now bronze so that the backcross doubles the number of bronze fish and this is certainly the best of the two choices.

There is however, a much more important difference between these two crosses if you want to produce as many bronze as quickly as possible

Let's look at the F-2 in Figure 2. The ratio of gray to bronze phenotypes is 3 : 1 (the famous Mendelian ratio). The genotypes of BB, Bb and bb however, are in the ratio of 1:2:1, respectively. What this means is that if you choose any of the gray for breeding, **you have a one in three chance of selecting one that does not carry a bronze gene**. Crosses between F-2 grays are the equivalent of one of the following, **(1)** the F-1 cross, **(2)** a backcross of F-1 to the P-1 gray, or **(3)** a cross between two pure grays. Crosses between the F-2 bronze and F-2 gray is the equivalent of either **(1)** the backcross of the F-1 to the P-1 bronze or **(2)** the original P-1 cross. The reason for the multiple choice is that the results cannot be predicted since the gray phenotypes are indistinguishable. As you can see, using the F-2 gray fry may not produce additional bronze fry and may even eliminate the bronze gene.

Well, what about the fry in figure 3? The phenotype ratio is 1:1 and it is the same as the genotype ratio. **No homozygous grays exist**. All crosses between grays are the equivalent of a backcross of the F-1 and bronze P-1. Therefore, all of the fry are useful for further breeding, avoid however, breeding gray to gray since some pure grays will again be produced.

Of course, if your stuck with having to make an F-1 cross, the best choice for the next step would be to use only F-2 bronze for breeding. If you're not satisfied with them because of other attributes then breed only bronze to gray, preferably a backcross of an F-2 bronze with the F-1 since this will, at least assure that all of the grays used are hybrids and all of the resulting grays will also be hybrids. The F-1 x F-2 bronze backcross is the equivalent of the F-1 x P-1 bronze backcross!

I could end the article here but I feel an obligation to the reader to point out that the above illustrations, while true, are most atypical. In most cases the guppy breeder is after male characteristics and although the females carry the characteristic, the females of the homozygous recessive genotype are indistinguishable from the females of the homozygous dominant genotype.

The odds of picking the correct female F-2 know one in four since there is only one female phenotype though there are still three genotypes. Diligent use of the backcross to quickly eliminate all homozygous dominant females becomes a necessity. The odds of finding the right female are then reduced to one in two. I recall one of our meetings, when one of our members asked when the bronze he had purchased would show up in his breeding program. He was up to the F-4 and getting concerned. From the above, I think you can deduce what had happened.

Next month we'll cover the X-linked and Y-linked genes.

GUPPY GENETICS

PART III - SEX-LINKED GENES

by Jack Rosengarten

In Part I it was mentioned that male guppies have a dissimilar pair (or non-pair) of chromosomes designated as the X- and Y- chromosomes, respectively, while the females have a pair of X-chromosomes. In Part II, inheritance of autosomal genes (genes on the other chromosomes) was explained with the presumption that the same results could be achieved regardless of which of the strains of an outcross contributed the males and females. The immediate consequence of sex-linked genes is that it is very important which strains contribute the males and females.

When I mention sex-linked genes the broadest common usage is implied, namely genes located in either the X- or Y- chromosome. Genes located exclusively on the Y-chromosome are actually known as Holandric genes. To avoid confusion I will use the more graphic terms of X-linked and Y-linked genes. The inheritance of sex-linked genes can be illustrated with the same system of squares used in Part I. The letters for the gametes now represent chromosomes instead of genes but, with the exception of crossovers (chromosomal Breakage), these are equivalent since all the genes on a chromosome move as a unit. **Figure 1** illustrates the expected offspring which, as might be expected, are 50% males and 50% females (other factors can change the gamete ratios in some strains).

		Male		
		X	Y	Y chromosome exclusive to males
Female	X	XX	XY	XX — Female
	X	XX	XY	XY — Male

Figure 1 - Sex Inheritance

Although the above may seem obvious, a careful examination produces some important rules, namely:

1. Only males can have a Y-linked gene.
2. Males can have only one X-linked gene.
3. Females have two X-linked genes.

Sex-linked genes fall into three broad categories which determine how their effects will be displayed. **They are**:

1. Y-linked without any X-linked allele. This can be called **exclusively Y-linked**.
2. X-linked without any Y-linked allele. This can be called **exclusively X-linked**.
3. **Incompletely sex-linked** meaning that an X-linked gene is an allele of a Y-linked gene.

First, let's deal with exclusively Y-linked genes. None of the texts I illustrated inheritance of sex-linked genes so that **Figure 2** is my own contrivance to illustrate this case. This figure is a mixture of chromosomes and a gene, but again, I see no harm since they normally act as indivisible units. The gametes are now X for the X-chromosome and YT for the Y-chromosome with the linked gene named T. The T stands for the tangerine-eye-line (TEL) gene which is a Y-linked gene. The TEL gene is exhibited in males as a line that starts at the eye and runs horizontally to just forward of the dorsal. I first saw this term used on these pages by Dr. Larr and recognized it as what I called the eye-stripe.

		Male: X	Male: YT
Female	X	XX	XYT
	X	XX	XYT

T - Y-linked tangential-eye-line gene

XX Female

XYT - Male with tangential eye-line

Figure 2 - Exclusively Y-linked

Figure 2 could be called the F- of an outcross of a TEL male and an unrelated female bu the same figure also illustrates the F-2, F-3, etc. In fact, this figure represents the cross of a TEL male with any female guppy The results are that 00% of the male fry will exhibit the TEL trait Incidentally, the use of a capital letter T is not indicative of a dominant gene in this case; since there is no competing allele it's presence will always be visible

How does a breeder distinguish between a Y-linked gene and a dominant autosomal gene? The males of both crosses are 00% like the father. For the dominant autosomal gene, only 50% of the F-2 males will be like the P-1 male. but, the Y-linked F-2 will be 100% like the P- male The most important difference is that the females of the Y- inked strain can in no way introduce this gene into another strain f you want to introduce the TEL characteristic to a strain, you must use a TEL male. If you need an illustration for an outcross using a female from a TEL strain, then it is **Figure 1**, and if you observe that the T gene is not present, hat is the point

The above discussion holds true for any exclusively Y- inked gene such as some of the half black or snakeskin patterns. The females in these half black strains will, of course not be half blacks

With exclusively X-linked genes, the effects upon the males and females will be different. Females can carry two X-linked alleles so that if they can exhibit the genes, the trait will be dominant, intermediate or recessive just as with the autosomal genes. The males, however, have only one X- inked gene so that whatever gene is carried will be exhibited

The X-linked half black pattern is a dominant gene in the female grey bodied guppy (I'm not so sure about the golds) Figure 3 illustrates an outcross between a homozygous half black female and a grey bodied male. The letter g for grey is used in keeping with the convention of letting the recessive trait name the gene

		Male: Xg	Male: Y
Female	XG	XXGg	XYG
	XG	XXGg	XYG

G - X- inked half black gene

g - X-linked non-half black gray gene

XXGg - Half black female

XYG - Half black male

Figure 3 - P-1 Outcross

The F-1 fry are 100% half black just as with a dominant autosomal gene Once again the difference can be seen in the results of the F-1 sibling cross shown in **Figure 4**.

		Male: XG	Male: Y
Female	XG	XXGG	XGY
	Xg	XXGg	XYg

G - X-linked half black gene

g - X-linked non-half black gene

XYg - Gray male

XXGG, XXGg - Half black female

XGY - Half black male

Figure 4 - P-1 Sibling Cross

The F-2 females are 100% half blacks and the males are 50% of blacks and 50% greys. If half black was instead a dominant autosomal trait, both male and female F-2 would be 75% half blacks. As with the autosomal traits, the heterozygous and dominant homozygous females are the same phenotype Culling these heterozygous females is not as critical as with some autosomal traits because the new half black "strain" can never produce a grey female as long as only half black males are used since the male cannot hide the recessive gene. Even if the heterozygous and homozygous female do not display the male trait, as is the case with the Zebrinus or Cobra vertical bars in the male) trait, the heterozygous female can be readily identified since one-half of her male babies will not show the trait

Now let's look at the above example from the standpoint of the recessive X- inked gene I've avoided referring to an X-linked grey gene because it probably doesn't exist. Most likely the recessive gene has no visible effect on the guppy

A breeder might acquire a half black male hoping to add size and other attributes to a grey bodied strain but without adding the half black pattern. This outcross is shown in Figure 5

		Male: XG	Male: Y
Female	Xg	XXGg	XYg
	Xg	XXGg	XYg

G - X-linked half black gene

g - X-linked non-half black gene

XYg - Gray male

XXGg - Half black female

XYg - Half black male

Figure 5 - P-1 Outcross

All the F-1 females are half blacks while none of the males are half black. The goal of eliminating the half black pattern is, therefore, easily obtained, but those other desirable traits disappear with the half black The half black gene is apparently linked with other important genes on the same X-chromosome. Of interest is the fact that the breeder, by using only half black females and grey males from the F-1 and succeeding generations can maintain a strain that throws 50% half black males and 50% grey males as illustrated in **figure 6**. Maintaining this type of strain greatly increases the chances that a crossover will occur between diploid X-chromosomes which could result in a new strain

		Male: Xg	Male: Y
Female	XG	XXGg	XYG
	Xg	XXgg	XYg

G - X-linked half black gene

g - X-linked non-half black gene

XYg - Gray male

XXGg - Half black female

XXgg - Gray Female

XYg - Half black male

Figure 6 - F-1 Sibling Cross

The explanation of incompletely sex-linked genes is fairly complicated and will be left for a later article, Next month we'll cover dehybrid crosses in which two pairs of genes are involved.

Guppy Roundtable Sept. 1973

REPORT ON BREEDING TECHNIQUES

PART 1 MULTIS

We have contacted the top breeders of each color class and have compiled the following report. It is hoped that this information will be useful to all guppy fanciers from novice to veteran in the right direction.

This and the following article should give an insight on how the top breeders approach the breeding of their guppies. The way we can encourage new breeders is to give them a helping hand and to give them the advantage of our mistakes.

For this issue we will report on the Multis. If there is anything that you can add as fellow breeders please send it in. This report can always be added to. We wish to thank the following for their help with this report

Bev Richmond - Gateway Guppy Assoc
Don Craft - Columbus Ohio Guppy Spec.
John Walsh - from Pennsylvania Guppy Club
Warren Burke - Big Apple Club
Frank Schultzebrandt - Big Apple Guppy Club

MULTI STRAINS REPRESENTED AND THEIR SOURCE

1. Bev Richmond: My source was Rich Szyank multis. I use 2 pure bred lines
2. John Walsh: Williams, Ted Hennings, Hong Kong Male with various females by myself
3. Frank Schultzebrandt: Gold red male strain produced one male that had two shades of red and another color - crossed him with two of his sisters. result: gold reds, gray bodied reds, red bis, gold multis, gray multis (I use grey male on grey females)
4. Warren Burke: Pure multi line
5. Don Craft: Male from show auction and my neutral female

It is interesting to note that the above breeders have been successful at shows and two use pure line breeding with their multis, two have used outcross method to hybridize. The fish was a crap shoot. It was previously thought that you had to hybridize for show quality multis, but the two pure lines above seem to disprove that. With a lot of work you can line breed multis. Breeder 5 had good luck in generation 1 but lost it after three generations

FEATURES OF THE STRAINS AS COMPARED TO AVERAGE:

Strains	1	2	3	4	5
Size	Aver.	Med. Lg.	Large	Aver.	Large
Tail Width	Aver.	Med.	Narrow	Aver.	Good
Dorsal	Larger	Med. Sm.	Large	Aver.	Good
Rate of Growth	Fast	Aver.	Very slow	Fast	Aver.
Rate Maturity	Fast	Fast	Early	Fast	
Fertility	Less*	Excellent	More	Less	
Cannibalism		Little	Less	More	
Susceptibility to Disease	More	Aver.	Less	More	

*1 Problem with females with large colorful tail, gravid spot tucks up and they are sterile
*2 Extra time needed to build red color
*3 My multis are super in color and breed true

---- Please note, breeder #1 and #4 who have pure strains have problems with fertility while the hybrid #2 and 13 did not. The size of the hybrids was larger than the pure strains, this is typical of hybrids. It takes a lot of time and work to develop a pure line

BREEDING TIME:

Strains	1	2	3	4	5
Time Kept Pure	3 yrs.	10 yrs	*	5 gen.	3 gen.
Siblings	*	50%		bl/gr *	*
% Desired Color	70%	50%	70%	45%	
% with Impurities		10%		15%	
% with other color		40%		40%	

* One line throws small % of males that are almost AOC Bi (cream with black dots) and also this line throws some males that almost appear to be two as they are so similar
*3 Not true breeding yet
*4 Siblings are Bl/GR to Red Bl. desired color 45% Red Bl.
*5. Had pretty good luck for 3 generations but because of lack of knowledge of background of male I lost both size and color

Because of the mixing no one has a high % of desired color with the exception of breeder #1 and that is a pure line

METHOD OF BREEDING TO MAINTAIN THE COLOR:

Strain	1	2	3	4	5
Inbreeding:					
Sibling Cross	yes	yes		*	*
Father to Daughter	yes	yes	yes	yes	
Mother to Son	yes	yes	no	yes	
Line Breeding:					
No. of lines	2	6	2	6	
Crossed after No. Generation		3-4	3	4	3

*4 Only one cross on yellow then Bl/G to Red Bl
*5. After 3 generations lost size and show quality ceased
The only pattern here seems to be that all breeders outcross every 3-4 generations.

EFFECTS ON COLORATION OF CHEMICALS, TRACE ELEMENTS, FOODS, ETC.

Strain	1	2	3	4	5
Foods	*	*		*	*
Chemicals	no	no	no	no	
Trace elements	no	no	no	salt	
pH of water		7.	acid	7.2-7.4	8

* . Have not tested
*2. No color food used. 6 to 8 different foods.
*4 Food, brine shrimp, microworms, fish roe, beef liver, green vegetable flakes, I use teaspoon of salt only in new water 25% change weekly
*5. I feed live brine shrimp for first two months and as the fish grow continue feeding with tetra flakes and frozen brine shrimp
Because our breeders are very successful it is not suprising that they all feed a varied diet.

METHOD OF BREEDING SHOW FISH FROM THIS STRAIN:

Strain	1	2	3	4	5
Same method as for Maintaining:	yes	yes	yes	yes	
Controlled Hybrids:	yes	yes*		1 cross	
Pure strains?	2	6		Several	

*2. Used to control size

*4. According to color you like

The multi breeders do seem to outcross more often then breeders of solid colors. This does add more adventure to breeding the multis then when you deal with solid one bred strains

OUTCROSSING - THE EFFECTS ON COLOR

Strain	1	2	3	4	5
Blue	Lavender Blue	pr unpred		Intense	
Green		little		lt. intensity	
Red	nice	good		very intense	
Multi	good	yes		very intense	
Snakeskin	poor	no		our good	
Other		bi/color		*	

*4. All guppies should be crossed after 4 generations.

The crossing of multis into other colors is not predictable. Each one is so different genetically there is no way to know except through testing each color and this takes time

IF ALL OF THE STRAIN WERE LOST EXCEPT ONE LONE MALE WHAT WOULD YOU CONSIDER TO BE THE BEST OUTCROSS TO PRESERVE THE COLOR?

Another Multi

2. Purple - Blue - Red or Piega Pink
3. Try crossing to a B. or maybe a snakeskin or some of Vic Pitco's neutral strain.
4. Cross with 6 different females and if you get desired color

There doesn't seem to be any pattern in multis, just trial and error

GOALS FOR PICKING BREEDERS AND FRY EXPECTATIONS:

1. Bright clean colors with at least 3 colors in the dorsals - also serve for iridescence
2. No answer
3. To get multi with at least 3 colors totally variegated with large body and caudal with nice notched dorsal.
4. No answer/
5. No answer

SELECTING BREEDERS - FEMALES:

Strain	1	2	3	4	5
C/B ratio	x	x		plump	
Body size	x	short-stocky	short	1½ inches	
Body shape		stubby	thick peduncle	plump	
Body color		pronounced	best multi	mod. in gray	
Caudal size	x	large	large	40% at 3 mon.	
Caudal color	x	Multi	Red Var.	solid	
Caudal shape	x	Delta	round	round	
Dorsal size	x	large	average	1 unit high	
Dorsal shape	x			proportioned	
Dorsal color	x	color	color	dorsal same	

SELECTING BREEDERS - MALES:

Strain	1	2	3	4	5
C/B ratio		show quality		no crown	
Body size	x	x	large	good dorsal and caudal	
Body shape	x	large girth	lg. per.	¼" body	
Body color	x	Cd. Var.	x	Same color as in caudal	
Caudal size	x	large		Delta 60% Veil-45%	
Caudal shape	x	Delta	Delta	clean	
Caudal color	x	Multi	3 color	same as females	
Dorsal size	x	lg. round		1 unit ht. 3 unit length	
Dorsal shape	x	flowing		1 to 3	
Dorsal color	x	match		same as female	

#1 Don't every thing is important but I stress color and size

#2 Maintain true multi color

#3 Breed in pectoral fin if possible which is also a color of the caudal and dorsa

#4 Check for razor cuts.

BREEDING AGES, SIZE OF LITTERS, RATIO OF MALES TO FEMALES

Strain	1	2	3	4	5
Age bred Male		5-6 mo	6-8 mo	5 mo	
Age bred Female	young	5-6 mo	4 mo.	3-4 mo.	
Ave. litter size	15/50	20/30	30/40	25/35	35
Ratio M/F		50/50	60/40		

Breeders #1 and #4 with the pure bred line multis tend to breed earlier this may be because they have a fertility problem. The other breeders who don't have this problem can wait and their fish are older and can judge them better

GENETIC TRAITS BELIEVED CARRIED BY THE DIFFERENT SEXES.

Strain	1	2	3	4	5
Body Size	both	both	M	both	
Body Shape	both	M	F	both	
Dorsal Size	both	both		both	
Dorsal Shape	both	M		both	
Dorsal Color	both	M	both	both	
Caudal Size	both	both		both	
Caudal Width	both	M		both	
Caudal Color	Both	M	both	both	

Breeders #1 and #4 with the pure Line multis state that genetic traits are carried by both the male and female. Because no pattern developed between the other breeders no conclusions can be drawn

SPECIAL PROBLEMS WITH THIS STRAIN:

1. Fertility problems, lyre tailed males or lack of "straight edge ortcAud41
2. Maintaining of red in multi color, not to have AOC and Bi color dOminant," also keep pure line mut when crossing
3. No answer
4. Snakeskins - pastels - greens - golds

FAVORED ENVIRONMENT FOR KEEPING THIS STRAIN:

Strain	1	2	3	4	5
Salt	some	yes		yes	
Spec. Diet			*	*	
Spec. Environ.	*			box filters	
Tank size	10-20 gal.	15-20 gal	10-20 ga	10 gal.	

#1. Duckweed and algae

#2. Tubifex. Fish roe, fresh shrimp mixed in blender with vitamin B-12

#4. Brine shrimp and mosquitoworms

COMMENTS OF THE BREEDERS :

This is a fascinating strain for two reasons. The dorsals are truly outstanding for a multi and the colors are vivid. Secondly, in nearly every drop of one I get a few AOC Bi-color multi males, and then the majority are regular tri-colors, but within that group often there are two males that are look alikes. These are great for tank entries. It is very challenging to line breed multis, that keep 3 colors in the dorsal, keep the colors bright and retain a tight pattern in the caudal. It is a lot easier to outcross using other color strains and grow a large hybrid for show, but I feel that I have accomplished more if I can win with a pure line bred multi.

2. Constant work by hybridizing to maintain large size,constant effort to keep red color in part of the multi. This strain is a challenge, as much disappointment takes place when you hybridize by washing out desired multi coloration. One of my favorites to work with, as results are never predictable,

4. According to the strains you keep they vary in crossing, maintaining their true dorsal color and caudal, I always cross my lines after 4 generations in all. All males kept separately at all times the same as in females,

OUTCROSSING, ADDING RECESSIVES, LINE BREEDING

by George McCroskey

Any guppy nut with poorer guppies than he would prefer will always come up with the comment on the drop of a hat "His stock needs new-blood" or in other words, a couple of new fish to add into his own would likely cure things very nicely, On which comment, a lot of mis-representation can, and often does happen

For the sake of the subject at hand, lets say you just happen to be one of the people as stated in paragraph one and you wish to obtain some "new" quality guppies for the purpose of breeding with your own. If you follow the general trend, all you actually wish is some new guppies that 1) LOOK better than your own and are of approximately the same color, and 2) these are within your means financially and otherwise. I think that past experience will show that the average guppy hobbyist assumes that once he can fulfill the above two needs, from then on he will have it "made" To which statements I can safely say that this assumption is one heck of a poor way to proceed, except for the occasional individual who has more luck than is good for him

Like most everything else, gives full returns for the money, and new blood that is added to existing guppies now on hand, a little advance planning and thought will be well-worth the time and trouble taken. The old time way of breeding guppies "by guess and by golly" maybe still used by those that have no better information to go on, but the modern methods of guppy breeding still makes the best sense and gives the ghest rewards.

It is only natural to want a new guppy male that is highly colored with a wide triangular-shaped tail and think this is the exact kind to add into your own fish However, without some sort of background information on the parentage of the fish, it will be some months before you can know for sure what you actually have At best if the guppy is totally unknown to you, the chances are 50-50 that you will even be able to get young (by use of your own females) from such a mating Chances are even more slim that any resulting young will be an improvement to what you would normally have It all narrows down to the fact that the truth about guppies is that seldom do they breed as you wish, or can reliably forecast With unknown stock, and with doubtful genetic background, observing the offspring, when and if these appear Perhaps few personal examples, all true, will better put across what I am trying to say

I was sent some excellent appearing blue delias one time The breeder who furnished these was the best known for these blues and it took some persuasion to get some of them On arrival, they did look good, but somehow I had the feeling the fish were not as they appeared. So I did not attempt to blend them into my own blue stock. I am really not strong on blue guppies anyway. It took two generations of the strain to show up the discrepancy They were heavily mixed, with pale red guppies later on, I heard the man outcrossed with reds at intervals to maintain the proper shade of blue. A person buying these fish, and using them to add new blood to his own pure blues, would likely end up with the most mixed up conglomeration of colors to where he would be worse off than he was when he started

Just recently, two members exchanged guppies of a particular color The less experienced of the two noted that the second generation of the fish he had gotten were all appearing with ragged tails. He immediately thought of disease, such as tail rot, or vitamin deficiency, or something similar However he did inquire to the other person in the trade who admitted the fish were originally from a strain of swordtail guppies not too far removed This then was the apparent tendency of the young to revert towards the more dominant swordtail trait A not uncommon occurrence BUT one that can be misleading if not known about Let me take this trend one step further

Some years back, when triangular tails were first appearing in small percentages of the more common

veil-tailed guppies, someone noted that the strains that showed up with the best triangle tails always seemed to show a very few male fish with some type of swordtail. Of course, like so many new things are, this was "laughed off" joked about, and discounted as pure coincidence. Only a very few breeders kept quiet, watched closely, and did some experimenting and observation to see if swordtail genes could be used to make better delta guppies. If any real progress has been made in this direction, scientifically speaking, I have not heard of it. But if any guppy breeder of note agrees that any strain of guppies that shows up with an occasional swordtail male, is usually the best available. On the other hand, if one deliberately adds in more swordtail mating, the tail quality will show it very quickly as mentioned in the former example. Apparently, it is one of the narrow paths a guppy breeder must tread to do best, just allow a small trace of swordtail trait to mix in, but not enough to become so dominant as to effect tail strength and quality. My own private opinion, for whatever this is worth, is that the original strains of guppy formerly used to make wide tailed guppies, always were the very one to naturally tend towards swords. If anyone reading this can go away back when fancy guppies were quite poor (comparatively), and well mixed with common guppy types, always some male fish appeared with the typical swordtails. The same thing could be said for wild guppies back then, if enough fish were there to pick from, swordtail types could be distinguished. Even closer to home, if you carefully observe a top, bottom, or double-sword male guppy, and they are reasonably good, they have a good angle on the typical swords in the caudal. If you can imagine this open space between the points as filled in, invariably it would "make" a wide tailed (even near-delta shaped) fish.

About three years ago, I read the theory that the addition of golds (or even a blond) to any fancy guppy strain would help to eliminate color mixtures and discrepancies. However, it was quickly shown that the use of albinos was hard to do as they were scarce, extremely hard to breed, not of the tail quality of most grey guppy kinds, and the addition of albino genes tended to weaken the strain in a number of reactions. In comparison, gold guppies had flaws, too, but in a very different direction.

Not many people cared to breed gold guppies. While small-tailed, gold guppies were fairly easy to procure, wide tailed kinds were quite hard to come by, were usually mixed parentage, and combining them with your best reds for the purpose of eliminating black coloring was only temporary at best, with the side-effect of decreasing tail width, inferior or less than true-bred gold stock. Also, people tried the opposite approach and attempted to add exotic colors to the gold bodied guppies with less than spectacular success for quite awhile. However, if enough people persevere, and enough exchanges of guppies take place eventually success of one sort or the other has to take place.

The best example, pulled from my own experience, is the original half black guppies with a black tail. These almost invariably were somewhere along the quite small percentages, usually one was lucky to see two light colored fish (male or female) in a hundred baby half blacks. Which proved they were an extremely recessive type either due to being far back in the ancestry as compared to the half blacks on hand, or that the half black colored effectively suppressed the lighter color. Speaking for myself, it seemed to be a little of both and took a lot of patience and time (plus tanks) to get either strain (half blacks or golds) to inbreed enough to where usable amounts would appear. Which brings up another point.

The coloring of gold guppies is recessive to the more normal grey body coloring of guppies. This simply means that the gold color will not appear in the resulting young guppies from such a cross. But, if one takes a male and female form these same mixed breed fish, mate them together, then you will get gold colored guppies. The amount of these has been well worked out by laws of heredity, and it follows closely to these laws if one takes the time to save, count and classify the baby guppies. 25% golds, 75% grey guppies, F 2). Any reliable book on guppy breeding, or genetic volume will give you this information so I will not bother to repeat the facts. To be brief, the percentages of golden young obtained by breeding brother guppies to sister guppies will gradually increase with the amount of inbreeding if you have the desire to make a strain of true-breeding gold guppies.

By this time I can hear the readers complaints; "What will I gain by out-crossing to gold guppies?" So taking it a logical step at a time, here is what one can reasonably expect to get, provided such is wanted.

Hybridizing, in its fullest meaning, is the act of cross breeding two unrelated species to produce "hybrids". The mating of a female horse to a male donkey, with the end product being a mule-hybrid is one such example. Regrettably, no real or accurate hybridizing of guppies has every been done to my knowledge with this meaning a cross to some other type of fish. However, the generalized use of making hybrids is commonly used with fancy guppies in meaning to cross two strains of guppies that are not related to one another but are still guppies. To get maximum effects from such a cross in terms of vigor, increased body size, variation in coloring, or to "cure" partial sterility, it is best to use two guppy types that are as far removed from one another as possible, yet will make a compatible mating. In using the term compatible, it simply means that the end results of the mating will give the wanted results. Such hybrid crosses are often ones that give inferior results or incompatible ones. By use of golden guppies, the two kinds of guppies are removed from one another, genetically speaking, as far as possible with only albino guppies being further removed. Therefore, a cross of a normal grey guppy strain to a normal gold strain, will at the very least, potentially give maximum hybrid progress. This effect will be most immediately evident in the baby fish as they will appear larger and usually more active.

The mixing of gold and grey guppies has more far-reaching effects than the more immediate ones as stated above. However, it is only fair to mention that it does take some time, as measured in generations of guppies from the mixture, to see the more effective results. I am sorry to say that I cannot give reasons to why these effects happen, or even give plausible theories I have just noted they do.

INTENSIFYING OF COLOR. Breeders who carry guppies in somewhat acid water, or water that may lack certain minerals, but yet be fairly hard, will often complain about gummy coloration going "off" into other shades. Red, for example, going into pink or orange shades; Half blacks or 3/4 blacks with red tails often become, a lighter blue rather than the wanted dusky black or a charcoal grey. Green fish may fade out to a whitish blue, blue guppies into a mixture of pale blue with other clear areas in the color, or into yellow. Other colors not specifically mentioned may become bleached, of a dull rather than intense coloration. Irregardless of the the changes, they are not those wanted. While mixing in a bit of gold may not be a cure-all for these ailments, it certainly will help if enough generations of fish are carefully kept and cultivated. Generally speaking, only one grey-gold cross will be needed for the effects to accumulate. It would seem that while the golden genes are recessive to most of those normally associated with grey guppies, eventually with controlled inbreeding they become semi-dominant and therefore, the full effects to show does take time.

VIGOR. Most any fancy guppy breeder knows that with continued breeding of any color of fancy guppy the fish is apt to become smaller, less active, possibly semi-sterile, and often, with a loss in body size. An outcross to a related strain is the answer most often given to cure these ills, but if this out-cross is to a strain of related golds, the effects will be more spectacular, longer lasting, and less apt to inadversely effect the coloration. One personal example that I have been carefully watching is a red strain that I got in a trade. At the time of trading, I knew almost nothing about it, had no idea the one carried gold guppies and knew only vaguely of the strains origin. Twelve generations later, with close inbreeding, a good percentage of golds appear regularly, but even more important the red coloration is excellent, tail with and shape is even better than expected and it is one of the most active strains of guppies I have.

COLOR CLARITY: To most guppy people who are active show participants, purity of color comes very close to the top in wanted characteristics. In the past two years, most breeder entrants have been specializing in improving color and this has brought up some odd theories. From my own personal observations, all colors of guppies I keep on hand have been seen to hold color better, hold it longer, and be purer in the one single color in the caudal and dorsal, if they have some gold genes in the mix. Assuming that my own

experiences are not unique, I would suppose this same factor would help others.

BREEDING TIPS: As suggested before, one good reason for most guppy people not taking more advantage of out-crossing, is the lack of good, and reliable breeding type guppies to use. In the case of golden guppies, these are even more scarce. Guppies from commercial sources are often disappointing, those bought at show auctions are seldom good for breeding purposes, and I regret to say, guppy people needing new stock for making show fish, are extremely suspicious of strangers. Therefore, with the quality of strange guppies one is likely to obtain, out-crosses are seldom what they could be. This is still no reason why they cannot be made to work — all it takes is more patience. Rather than seeing success in the first young from such a cross, it may be far better in the long run to keep the fish, watch them closely, then the best results may appear in, the second, or later, generations. This information I have mentioned a few times before but it certainly bears repeating. Success with guppies does not come over-night, or even in a year, except in cases of extreme luck, or a lot of skill.

If you as a breeder desire to add a little gold stock to your own I suggest you watch local pet shops. Florida fish farms sell a lot of good guppies, but seldom are these likely to look gold, or be in the same category as show stock. These still can be useful to use as out-crosses as they usually are quite true-breeding for what they show.

One attribute about gold guppies that may not be fully realized. A gold guppy crossed to another gold guppy will give all golds. It does not matter how many times this same gold has been blended with grey guppies, he or she will still be true breeding for one thing — the gold coloration. Naturally, this can be mixed as to caudal, or dorsal colors, or even with portions of the body being colored, but the background, or body color will still be gold. The "gold" by the way, comes in a variety of shades, ranging from near-white (blonde) to all shades of gold, from pale gold to a deep butter yellow. In some strains, a litter of baby fish may show all color variations as described but it takes a sharp and possibly experienced one with golds at one to see the differences, especially in the baby guppies.

A line of grey guppies (red as one example I am familiar with) once crossed with golds will most always throw percentages of golds from then on — with these becoming more in evidence with close in-breeding. Generally speaking, the addition of coloring over the basic gold will be a variable but if at all possible, use red-golds for use with red-grey guppies, green golds with green-grey, etc. Naturally, if you can only obtain a gold guppy of one color, this is better than none at all and eventually, can be mated to another color with the body gold.

The best practice with out-crossing is to keep a strain pure-bred that is found (by actual experience) to be compatible with your own. If tank space is at a premium, a single tank set up to just keep on hand some of the strain needed will be adequate. Even better, as stated many times before, is to find another breeder or set one up with guppies related to your own and sway fish at intervals. This can be made into a series of "Line-breeding" methods, or just a way to allow someone else to work strains compatible to your own if they can be kept reasonably pure-bred. The above article is not meant to be the ultimate answer to all guppy problems for everyone, everywhere. It is just a series of suggestions that has been found to help.

Reprint Fancy Gupp Correspondence Club, Feb 1971

WHAT IS AN ALBINO?

by Midge Hirt

(Reprinted from the IFGA BULLETIN, June 1972)

This series will start with the albino, as it seems that there has been some discussion lately on this classification. * *(see the following two quotes by Mike Regent and Stan Shubel)*

"Webster's College Dictionary defines Albino as 'a person having a congenital deficiency of pigment in the skin, hair and eyes. Albinos in extreme cases have skin of a milky color, very light hair, and eyes with a deep-red pupil and pink or blue iris. Also any animal or plant similarly deficient in pigment.'"

What is the point of all this? I think there should be a change in the title of Albino class to Red Eye due to the wording in the IFGA Judging Standards. "Albino" the eyes are pink and the body albino or light pink." It makes no mention of caudal color. Which means any color fish with any color caudal can be put in the Albino class as long as it has pink eyes.

A long discussion was had at the recent Kokomo show on what constitutes a winning Albino? The answer given to me was as long as the fish has pink or red eyes it will be judged as any other class - brightness of color, etc., etc.

At this show was an albino that was almost white with a tinge of purple in the peduncle, also with pale yellow caudal and dorsal to match. This to me was the closest fish to a pure albino I have ever seen*. Granted, it was smaller than the winning fish and did not have as full caudal to body ratio, but it did have everything else to be a winner in the albino class.

Also it was said to me that...wouldn't an all white fish be sick looking? I personally don't think so, as I said, "I'd take a hundred pair of them."

I would like to propose a word change in the judging standards to read 'Pink eye class' rather than Albino class as this would be more fitting for the words written for this class in the standards. Maybe in the future there will be enough white or pink colored fish to constitute a true Albino class, and the word albino will be more fitting it's name."

Respectfully submitted,
Mike Regent

"Let me attempt to clarify myself once and for all about the gold or other color strains of guppies. A no-no time stated that gold crossed to gold would not produce gold guppies. I said that it is possible to breed out the buttery yellow gold body color. The fish for practical purposes would still be basically a gold strain but without the necessary body coloration that is required by the IFGA Standards.

In the true sense of the word a fish with a total lack of pigmentation would be an albino. However our rules state a fish must have a pink or red eye to be an albino, regardless of the coloration. The case being true with the bronze. A gold bodied fish is not a bronze. Our rules call for a dark gold body with each body scale edged in black.

What I am trying to get across is that we have standards for the color strains as well as for the caudal colors and shapes. If the standards are not applied you might as well lump all the fish together for judging purposes."

Stan Shubel

OK, there is the discussion...now let's take a more thorough look at the albino itself. Exactly what is albinism and how extensive is the loss of pigmentation?

Webster's description is, of course, basically right, but is too over-simplified to give a full picture (Somewhat similar to summarizing the Bill of Rights into two lines...much is lost). Perhaps a clearer description is given by A.M. Winchester in "*Heredity, An Introduction to Genetics*" .."Albinotism: this trait is characterized by an inability to properly synthesize the pigment melanin" (Melanin being defined as the pigment that produces black coloring, and affects any color that relies on any degree of black pigmentation.)

The key word is 'black', because the pigment that is missing in albinos is black...and black only. But, any color involving even the smallest amount of melanin (black pigmentation) will also be affected. Grey, brown, blue green and purple coloration in guppies is known to involve varying amounts of melanin. Therefore it cannot be expected that an albino guppy will show a bright blue, a bright green or a deep purple tail or even a grey body, as black pigmentation is involved in producing these colors. Instead, the pigmentation present in these color varieties, when reinforced by black, will show only as pale, pastel shades of blue, green, lavender, pale pink or even white.

But what happens in the albino to colors that do not involve black in their make-up? They are relatively unaffected by the lack of melanin. Red and yellow are two good examples of guppy colors that do not rely on black pigmentation. Small degrees of melanin can sometimes make the difference between deep red and orange, but other than that the presence of black or grey only tends to muddy the red color. With the black removed (as in an albino) the red-orange color is unmuddied and shows as a clear red. The yellow color shows as a clear, unmuddied yellow. Remember, albinism is the failure to produce the black pigment melanin.....and not all pigmentation in general.

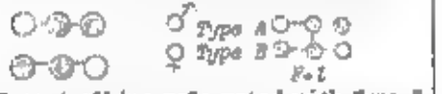
The red eye of the albino is NOT caused by red pigmentation. Since the normal color of a guppy eye is black, and since albinos cannot manufacture black pigmentation, the eye of the albino guppy is a clear, unpigmented window through which the blood vessels on the inside of the eye are visible.

What happens to the black pigmentation? To know that it is necessary to understand that the synthesis of melanin (black pigmentation) is accomplished by a chain reaction involving several factors. A break anywhere along the line can result in the inability to produce melanin, hence albinism (see illustration below). The break does not always occur in the same place, which is why there is more than one genetic type of albinism. As different breaks in the chain also produce different other side effects, the colorings and depths of color can change between albino strains of different types. (The formation of various other pigments are on different gene-controlled pathways about which a great deal still remains to be learned.)

Fig. 1 Melanin Formation

Amino Acids P & T react then go through a series of changes mitigated by enzymes to form melanin. The chain can be broken in one or more places and melanin will not be produced. Result: albinism.

Fig. 2 Crossing two albino types



Type A albino male mated with Type B albino female. When these chromosome units in fertilization, neither race give albino gene to paired, hence the F-1 fry will not be albino.

It might also be added at this point that just because an albino does not show evidence of color patterns involving black pigmentation, does not mean the albino does not carry these genetic patterns. For example, although an albino from a half-black strain shows only a pale blue or silvery body in the characteristic by half black area, he does carry the half black pattern genetically and will pass it along in the normal fashion to his fry. If the fry are also albino they too will not show black in that area,...but any outcross or hybrid fry will be the normal half black.

Another facet of this phenomenon that could be quite important to breeders, is that of black spots in the tail. It has been recommended in many pieces of literature that to eliminate black tail spots in red guppies "breed to an albino". This can work if the albino strain used is relatively free of black spotting genetically (but probably would be no more effective than an outcross to any red strain showing little black spotting). But using the above information it can be readily seen that such an outcross can also be a fiasco and produce even more black spots in the tail. Why? Because the albino can carry an undetermined amount of black being invisible because of the albino's inability to produce the black pigment with which to color these areas, the black patterning which is none the less there genetically and can be passed on to the fry, cannot be determined visually. Even though the albino shows not a hint of black spotting in its tail **THE GENES FOR THE BLACK SPOTTING ARE THERE AND ARE MASKED BY THE ALBINISM** (a much safer bet would be to outcross to gold, which can evidence its black contaminants.

Most forms of albinism are relatively rare recessive autosomal genes. (autosomal meaning it is not sex-linked and can occur equally in males and females...recessive meaning it takes two genes, one from each parent, to produce an albino). If two different types of albinos are mated, the result of fry will receive only one gene of each type and will therefore be grey not albino. (see illustration 2). (I currently am working with three distinct different albino types, any two of which when crossed produce only greys in the F-1. the F-2 gets really interesting. It has been proven that the albino guppy is not merely a more drastic form of the gene that causes gold or bronze (although differences in melanin distribution are also involved in these two body color strains), but is a completely different trait and unrelated to the other two in the genetic set-up.*####*

GUPPY ROUNDTABLE OCTOBER, 1973

PART IV

DIHYBRID CROSS

by Jack Rosenguren, IFGA (Guppy Roundtable, Oct. 1973

Until now the discussion has concerned the effects of one pair of genes, or a single gene in the case of sex-linked genes. Quite often, however, multiple pairs of genes or polygenes are involved. When two pairs of genes are involved a cross between two different homozygous strains is known as a **dihybrid cross.**

An example, of a dihybrid cross is the cross between a gold and a bronze guppy. Although both the gold and bronze body colors are each determined by a single pair of recessive genes, the pairs are non-allelic. It is possible, therefore, for a guppy to possess both pairs of genes. What does a guppy with the combined genes look like? To quote Marge Hill in the IFGA Bulletin

"In the case of the double recessive of both gold and bronze, the resultant individual has a distinct body color which differs from the gold by being a paler yellow color (melinophores are usually very few in number and are sometimes almost completely absent.) **Cream body color is the result of a combination of both bronze and gold** when both are in the pure state. **There is no gene for cream!"**

Let's look at what it takes to establish a cream line by starting with a single cream guppy. Of course, since we know the genetic makeup of the cream guppy, the best outcross would be into either a gold or bronze line. In order to illustrate the dihybrid cross, however, we'll make an outcross into a grey bodied line. **Figure 1** shows this outcross. The notation for a cream guppy is bbgg where b is the recessive bronze gene and g is the recessive gold gene. The homozygous grey guppy notation is BBGG, where B is the dominant allele of the bronze gene and G is the non-gold dominant allele of the gold gene. The gametes (eggs and sperms), most

now be represented by two letters to account for the two pairs of genes. Since the types are homozygous, all the gametes will be the same so that the system of squares can be reduced to a single square. What do the F-1 look like? Since there is neither a pair of gold nor a pair of bronze genes, the F-1 are all grey.

	bg
BG	BbGg

BbGg = grey phenotype

figure 1 - Cream x Grey Outcross

Just as with the monohybrid cross, the next choice is either an F-1 sibling cross or a backcross of the F-1 to the cream parent. **Figure 2** shows the sibling cross using a system of squares, only now there must be 16 squares to account for the fact that each parent can contribute four different gametes (2 alleles for the gold gene multiplied by 2 alleles for the bronze gene).

	BG	Bg	bG	bg
BG	BBGG	BBGg	BbGG	BbGg
Bg	BBGg	BBgg	BbGg	Bbgg
bG	BbGG	BbGG	bbGG	bbGg
bg	BbGg	Bbgg	bbGg	bbgg

b - bronze gene
B - non-bronze gene
g - gold gene
G - non-gold gene
BBGG, BBGg, BbGg - grey phenotype
BBgg, Bbgg - gold phenotype
bbGG, bbGg - bronze phenotype
bbgg - cream phenotype

Figure 2 F-1 Sibling Cross Combination of Gametes.

As in the previous cases the contents of each square is the combination of the column and row headings (gametes). To preserve order, the letters are written in alphabetic order with capital letters preceding small letters. Each of the 16 squares represents an equal proportion of the fry. A careful count using the legend in **Figure 2** shows the phenotypes in the following ratio:

9 grey: 3 bronze: 3 gold: 1 cream

This is the ratio where each pair of recessive genes affects the phenotype. Sometimes each recessive pair does not affect the phenotype. The ratios will then show various combinations of the above numbers such as 15:1, 9:7, 12:3:1, or 9:4:3.

As can be seen, the use of squares as in **Figure 2** can be cumbersome. There are several simpler methods, one of which is shown in **Figure 3.** The top row represents the genotypes obtained when only one pair of genes is followed using the squares. The left column represents the genotypes of the second pair of genes. The numbers in parentheses are the phenotype ratios. As before, the letters in the squares represent the combinations of the column and row headings, but the numbers are multiplied. Only as many columns and rows as are necessary are used.

	(1)GG	(2)Gg	(1)gg
1-BB	(1)BBGG	(2)BBGg	(1)BBgg
2-Bb	(2)BbGG	(4)BbGg	(2)Bbgg
1-bb	(1)bbGG	(2)bbGg	(1)bbgg

Phenotypes
GG, Gg — grey gg — gold
BB, Bb —grey
bb — bronzeCombination same as Fig. 2

Figure 3 - F-1 Sibling Cross
Combining the Genotypes of Each Pair of Genes

The breeder's problem in trying to establish a cream line by outcrossing to a grey one is considerably more difficult than working with only one pair of genes. The above ratios indicate that in the F-2 only 1/16 will be cream. That means that in 32 fry, on the average, only one male and one female cream guppy will occur. Since averages are seldom realized, there may not even be any cream guppies in this small a sample.

With the monohybrid cross, the backcross of the F-1 to the recessive P-1 was better than the F-1 sibling cross. Will this hold true for the dihybrid cross? **Figure 4** illustrates this case, which genetically is **bbgg x BbGg**, using the method of **figure 3**. The row and column headings turn out to be the genotypes of a backcross for a single pair of genes. **The parenthesis numbers are not shown as they are all one (1).**

	Bb	bb
Gg	BbGg	bbGg
gg	Bbgg	bbgg

Phenotypes per Figures 2 and 3

Figure 4 - F-1 x P-1 Backcross

As can be seen, the ratio of phenotypes is now— 1 grey, 1 bronze: 1 gold, 1 cream

The backcross, therefore, yields four times as many cream guppies for the same number of fry. The F-1 x F-2 cream will also yield the same proportions. Just as with the monohybrid cross the grey F-2 should be culled since using them could lead away from the goal of a cream line.

The genotype ratios of the above examples apply to any dihybrid cross. As mentioned earlier, the phenotype ratios will vary depending on the effect of the genes.

As an example, take the above case. If the bronze and gold body colors could not be expressed but instead, were just add more greys. The F-2 would then have a phenotype ratio of 15 grey to 1 cream.

If two types of a non-allelic albinos were crossed, the F-1 would be grey since a matched pair of albino genes is needed for the fry to be albino. The F-2 will have a phenotype ratio of 9 grey to 7 albino. The F-2 albino consists of 3 of each type of albino and 1 double (both types combined) albino.

In a cross between a gold and an albino, the F-1 are again grey. The F-2 now have the phenotype ratio of 9 grey to 4 albino to 3 gold. One of the four albinos is actually a combined gold and albino.

More complex cases where three or more pairs of genes are involved could be described, but these start to outrun what can be counted in a number of guppy grey. With three pairs of recessive genes, only 1/64 of the F-2 matings to a dominant type will exhibit the recessive phenotype, and if it is exhibited by only one sex, then only 1/128 will exhibit it. Similarly, with four pairs of recessive genes, only 1/256 of the F-2 will be the recessive genotype. Each pair of genes reduces the chance of a homozygous recessive showing up in the F-2 by a factor of four.

A SPECULATION

by Jacque Kovacs

An acquaintance of ours was trans-shipping fish, selling to pet shops

He keeps spotless, balanced tanks, always checked the pH before transporting to the shops. He was meticulous in every technique, he knew to avoid the dreaded killer shock

After several incidents of having his delivered fish die, within one day of delivery to a pet shop which he knew was as careful as he was, he began checking the pH at the shop right on the spot of delivery

Was he surprised! The pH balance was very acid less than 1/2 hour after receiving perfect

He finally tracked down the trouble: he had been smoking when bagging the fish, had blown into the bag, and enough of the smoke had done the dirty work.

How many guppy mortalities could be traced to this especially transporting or shipping to and from shows?!

TO GETTER COLOR IN GUPPIES

by Fred Samuelson

ED Note: While this article is a reprint from way back in 1972 I have it on good authority(?) that it still holds true

Breeding guppies for color can be accomplished while increasing or maintaining size and vigor. Careful selection is the key. Always start with good fish from a reliable breeder who maintains set ones. Also remember that optimum living conditions and proper diet are vital to the proper breeding and maintenance of good fish.

I have developed and used the following procedure for many years. It is a concept in breeding, with the flexibility required for color control. It allows for new blood to be added and aids in the maintenance of good vigor. Genetics, heredity, recombinations and control by selection are the basic factors. True, there are many possible recombinations. However, this method does work! I have some strains that have been working for many years and more

Before any cross breeding of fish can be started, the color lines of the guppies must be established. To establish color lines, it is best to line breed, for in-breeding can result in hybrids if the fish to which you cross also happens to be inbred. Blue strains and red strains should generally be line bred for three generations to establish color, while green strains require but two generations of breeding green to green for color stabilization. However, some variation in body color may still be expected when crossing.

The base color line I use is red. After breeding the line in the color red for three generations, the first cross is made. This cross should be made to a blue line, using a good male from a line that shows the average male to be of good size and vigor.

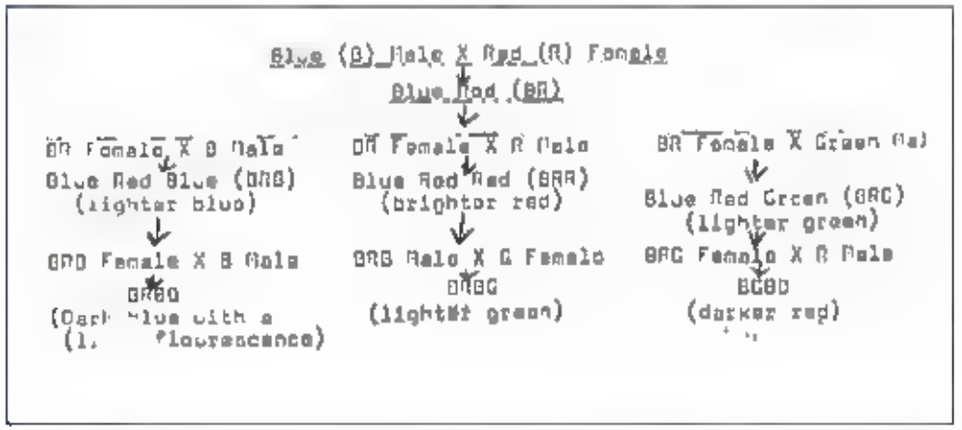
If the first cross is successful and the progeny are of good size and are vigorous, you have successfully started line color breeding. Make a note of the lines used, both red and blue, and keep this for reference in future crossing. I use the following system to denote lines in my records

CROSS
Blue male cross red female
Blue Red spawn back to blue
Blue Red spawn back to red
Blue Red Blue second breed to blue
Blue Red Blue second breed to green

SPAWNS	
BR males	BR females
BRB males	BRB females
BRR males	BRR females
BRBB males	BRBB females
BRBG males	BRBG females

Thus, you are aware of the lines background across three or more generations. Also, numbers can denote color lines, as 01 or 3 for separate blue lines. Therefore, the progeny of a cross between red line three and blue line one would be R301. This type of notation is also used for work with friends if you do not have sufficient tanks to maintain several lines.

The females of your first successful cross of red to blue may be crossed to either another blue line or back to a red line. Crossing to a blue line produces lighter blues while crossing back to red produces brighter reds. If the females are crossed with blue males, the lighter blue females resulting from the cross should be used for crossing with green males. This will help produce a lighter and brighter green line. Also, green females resulting from this cross can be used to cross back to the red line to deepen the red color. Such a crossing scheme is depicted in the diagram.



Remember to preserve virgin females from each cross, for use if mutation occurs or for use in further crossing.

When breeding is performed properly, the same variety and strain should be consistently good. A good breeder maintains his fish under optimum conditions throughout the year.

THE BASIC MAINTENANCE RULES I SUGGEST ARE:

1. Change of the water weekly, adding an additional amount to cover evaporation loss.
2. Feed often and in small amounts never overfeeding. Three to five feedings daily should be sufficient. The diet should consist of highly nutritious food, rich in protein. Tubeworms may be fed twice weekly. Naturally, the staple foods of our diets are resultfoods.
3. Tank population should not exceed 1 1/2 inches of fish per gallon.
4. Keep aquaria clean.
5. Plants, if used, should be of soft leaved varieties.
6. Clean filters weekly, washing the charcoal and replacing glass wool.

This article has considered three of the four keys to breeding and control; the breeding concept, environmental conditions and diet. The fourth condition, we assume. This is the diligence of the breeder.

REPRINTED FROM Guppy Gossip, Guppy Assoc. of Greater Cleveland

PRACTICAL GUPPY BREEDING

by Warren Burke

Lets start off on selecting the best male and female. Always remember, one way to improve in guppies is to mate the best male and female of your stock. Always keep in mind we are working with the same strain now. But if we are to understand what we are doing, we must know first some of the terms of the student of heredity--the geneticist. Many geneticists get more enjoyment from their work than students in any other field.

It is usually difficult for boys and girls (and grown-ups) who have had no training in raising fancy guppies. The inheritance of acquired characteristics. If a fish tends to change it's color to resemble its background and this, accommodation goes on generation after generation, there are those who say that the acquisition of the acquired shade will be inherited. It will not. This is an acquired characteristic and acquired characteristics do not impress themselves on the germ plasm (the blood theory). We talk about pure blooded fish when we mean highly bred or pure bred specimens. The word blood is used mistakenly in place of the word heredity. This is a mistake and gives those who use it and those who hear it the idea that heredity is a case of dilution. Consequently it is difficult for them to grasp the fact that heredity is a case of presence or absence and not one of dilution.

When you cross a grey guppy with a pink-eyed albino, you do get a lighter grey, but one like the grey parent. When you cross a gold with a gray you do not get a mixture, you get grey.

There are a few instances indeed where the results of crossing involves single traits which give blends or dilutions, and none so far discovered in guppies. So it is better not to use the word blood when you mean inheritance. Use terms such as pure-bred, breeding heredity. How then do guppies inherit? In some strains you always keep in mind the dark pigments will overcome the light gold or albino pigment. More to follow later.

THE SNAKESKIN---OR KING COBRA GUPPY

by Dr Chee Sek Joong

Whether the guppy is a grey guppy or a golden guppy or an albino guppy, their body patterns can be classified into three types.

1. Ordinary type with red and blue green patches and black spots. This colour pattern resembles the pattern of wild guppies.
2. Half black or three quarters black type - half or three quarters of the body is black or blackish black in colour.
3. Snakeskin or King Cobra type. Here there are fine iridescent, silvery markings on the body. This is the type of guppy that the present article is dealing with.

What is the snakeskin or King Cobra Guppy? What should it look like? How can I tell whether this is a genuine snakeskin guppy or not? Should it have one or two black dots in its body or none at all? What should its colour be - in the body and in the tail?

According to Mike Reed, a three quarter black male with unusual markings in its body was brought into the United States from Europe, presumably Germany by the late Paul Hahnel. Hahnel presented this male guppy to Fred Reitz, a guppy enthusiast. Reitz, after working with the fish for a while, gave some of his stock to his friends, Mac Kalicheiam and Jano Cardillo of Mac Guppy Hatchery in New York. These two crossed the male with their females of fixed strains, for example, their strain with blue green multicoloured tail, their strain of red tails, etc. From the result of these crossings and by further interbreeding, the King Cobra Guppy was developed and fixed by them. From the blue-green multicoloured strain they got the blue and green King Cobras and from their red strain they got their red King Cobra which has either a green or blue body with a red tail. They also developed a golden King Cobra -- which they named the Sunset King Cobra. This fish had a golden body with snakeskin markings and a red or yellow red tail. Note that if you cross the female King Cobra with an ordinary male the male offspring will not have the snakeskin markings. The article on this appeared in the May issue of *Tropical Fish Hobbyist*, 965. They name this fish the King Cobra Guppy because the iridescent wavy white lines on the body of the fish give it some resemblance to the skin of a snake.

The next year, June, 966, the owners of the Mac Guppy Hatchery proudly announced the production of their albino King Cobra Guppy. This fish has a golden body with snakeskin markings and a red tail. About the same time as the Mac Guppy Hatchery was engaged in the breeding of the King Cobra Guppy, another professional guppy breeder William Hartung, was also extensively engaged in the breeding of the snakeskin guppy. This man is famous for his variety of golden guppy which he named the Bronze Delight and which he claimed was a firm hybrid of the ordinary grey and the golden guppy. To me the bronze guppy is just another variation of the golden guppy, like the blonde guppy which is lighter in colour than the golden guppy, while the bronze is a little darker. William Hartung produced three types of bronze snakeskin:

(1) bronze yellow tail snakeskin,
(2) bronze red tail snakeskin;
(3) bronze double sword snakeskin.

These fish have a greenish yellow body with snakeskin markings. In addition to the bronze snakeskin guppies he also produced the albino snakeskin guppy and I believe he was the first man to produce and market the albino snakeskin guppy -- about 1 year before Mac Guppy Hatchery announced the production.

of their albino snakeskin guppy. Also, he produced several types of grey snakeskin guppy

greenish snakeskin - green body with snakeskin markings and a black or greenish black tail with yellow markings.

2. leopard tail snakeskin - green body with yellow tail and black dots. 3. doublesword snakeskin guppy

From the interbreeding of my own snakeskin guppies another variation was produced. This fish has a yellow green body with snakeskin markings and a lace veil tail. Also double swordtails were produced.

Other breeders in Singapore have also produced the snakeskin guppy with a bottom sword or an upper sword. From my own breeding experiments I am of the opinion that the snakeskin guppy originated from a mutation of the Viennese emerald double sword guppy because the double sword snakeskin guppy has a strong resemblance to the Viennese double swords.

A good snakeskin guppy should have horizontal markings on its body but these not so highly developed will show three or four vertical bars at the posterior one third of its body (caudal peduncle) and some in addition have red vertical lines on this part of the body. Most fish have one, two or three black dots in the anterior part of its body. However, the highly developed fish may not have any black dots at all. The more those iridescent white markings are seen, the better the fish looks and the markings are finer or narrower. Those fish that have fewer markings also have broader markings and in some you can hardly see the markings at all. Of all the snakeskin guppies, I believe that the most striking and beautiful ones are those with a dark green body, which some name the emerald snakeskin guppy. If you can produce a strain of snakeskin fish with

(1) a dark green (emerald) body with many fine iridescent markings
2. a multicoloured caudal fin,
(3) a large rectangular dorsal fin with leopard or spotted markings you have achieved the ultimate in guppy breeding. ###

Reprinted from the, 1971 RAGGED TALES published by the Guppy Associates of Toronto

Editor's Note: I reprinted this article mainly for its historical content since some of the materials now dated. The IFGA has adopted standards which describe the snakeskin as having a reticulated body pattern. The vertical bars, also known as a zebrinous pattern, are now considered defects in the snakeskin classes and lose points in the judging. A fish with only zebrinous bars is not considered a snakeskin, at one time it was admitted to compete in classes called snakeskin-cobra classes. Cobra is no longer an IFGA term. Those zebrinous bars are caused by dominant autosomal genes and thus can be bred out of the Y-linked snakeskin pattern strains. Snakeskins can be crossed into almost any strain and, as indicated above, yield many interesting combinations. I've heard that some snakeskin patterns are X-linked but I haven't come across them. I had some snakeskins which used to throw both double swords and veiltails and both had different snakeskin patterns; the double swords also had the pattern on the tail. Since the snakeskin is Y-linked, the type of tail must have changed the way the pattern was expressed. IFGA also requires that the caudal and dorsal color match (or lose points). A matching body color also picks up points.

Variety in Guppies when space is limited

By Midge Hill

Most guppy breeders love variety - this is usually why they pick guppies in the first place. But raising a large variety of different types properly takes a great many tanks and a lot of space. It is simple to fill 9 tanks with just the offspring of one particular kind of guppy - but if you like variety it as possible to properly work and improve as many as 7 different kinds of guppies in these same 9 tanks by using the following breeding program.

Note, I did not say 7 pure strains! This "short cut" technique is not to be confused with maintaining pure strains - for which there is no really successful short cut of which I know). You will eventually end up with your own pure strains if the program is followed throughout, but in the beginning this is strictly a creative technique (which in fact can be very satisfying) - a way to expand without adding more tanks.

For the sake of illustration, let's assume that our guppy rearing space is limited to 9 tanks (15 gallons or larger). The first step of the whole breeding program is to decide what basic color you prefer. Then comes the most important step of the whole breeding program - one which will decide the success or failure of all your efforts. - select one of the basic, pure strain which will be behind all the other variants in the 9 tank program. Don't scrimp here - shop around, talk to breeders - learn as much as possible about each strain, then purchase the very best, truest-breeding strain you can find in the desired basic color----hopefully one that also carries a recessive trait such as Gold, Bronze or Albino body color.

This becomes your BASIC strain. Breed the new strain immediately and when young are dropped, remove mom and dad to a holding tank. No attempt will be made to save the future litters unless tragedy strikes the first litter. When fry are old enough, be sure to separate males from females. IN TIME! This is vital as these young females will be the backbone of all the other varieties in the program and will be the only females that we work with at all.

While these basic strain fry are growing in tanks 1 and 2, start looking around for other fish with which to start the variety part of the program. A little knowledge of genetics helps here as most of our varieties will utilize dominant characteristics which are visible in each generation. Most varieties of cobra or snakeskin are carried on the Y chromosome and will therefore be passed directly from father to all his sons. Some varieties of Half or Three-quarter Black carry the trait on the Y chromosome also and would be ideal for one of our variety. If carried on the X chromosome they can still be used but require slightly different crossing methods and will produce 50% of the desired Black variety (except possibly in the initial cross) when bred in accordance with our program. If the basic strain carries recessives for Gold, Bronze or Albino we do not need to seek an outside mate for these characteristics as we can use a mate from the basic strain to work this variant. We can also add a color variant, which will often throw multi-color when crossed into our different color.

For the sake of illustration we will select a Cobra, a Y-linked 3/4 Black, and a good fish of a different color than our basic strain (which we will say already carries a recessive for gold). From these three plus the basic strain we can raise in only 9 tanks 7 distinct varieties of guppies that will be breeding true for their variant characteristics, and in time all will be pure strains.

The Program can be started when the basic strain F1 females in Tank 2 reach breeding age (about 3-4 months)and will be set up as follows :-

Tank 1. Basic strain females, first litter

Tank 2. Basic strain males, first litter

Tank 3. Cobra. (The selected cobra male, 3 virgin Grey females from tank 1 plus one gold female from tank 1)

Tank 4. 3/4 Black*. (The selected 3/4 Black male, 3 virgin females and one, at least gold female from tank 1,

Tank 5. Gold (or Bronze or Albino). Select the most promising Gold male from tank 2 Add two or three females from tank 1

Tank 6. Gold Cobra. (First litter will be Grey bodied hybrids all carrying gold) When gold females in tank 3 are heavily gravid move to tank 6 to drop the brood.

Tank 7. Gold 3/4 Black,(First litter will be Grey bodied hybrids). When gold females bred in tank 4 show signs of pregnancy, remove to tank 7 for delivery.

Tank 8. Multi (or some form of color variant) Put selected male of any color different from the basic strain color with three virgin basic strain females from tank 1

Tank 9. Holding tank for mature males, .to show, sell or for emergency.

In case of X-linked 3/4 Black the process should be reversed- -if a virgin female of the 3/4 Black strain is available she is put in tank 4 with the best basic strain male from tank 2. If no virgin female is available, put X-linked 3/4 Black male with three virgin basic strain females. In the F1 only the females will be black and breeding plan will remain reversed. basic strain male to 3/4 Black female for each new generation. Only 50% of males will be 3/4 Black it would pay .o look for a Y- linked 3/4 Black male when breeding according to this program

When females in tank 3 through 8 are well loaded, remove the males to tank 9 After fry are dropped remove and discard the female parent Sex fry as soon as possible and DISCARD all females as soon as sexed except the Gold females in tank 5 which should be added to tank 1 to increase the supply of basic strain females with which to work As young males begin to color up discard any that show undesirable characteristics As they mature gradually weed out all but the best

While they are maturing we will turn our attention back to the basic strain which should be kept moving along and improving as so. Being at least three months ahead of the variants, we can now select the very best male in tank 2 and remove at least three .o tank 9 (in case of emergency). Select the best three females from tank 1 and put the male in tank 2. When fry are dropped continue as before: discard parent females, sex fry, remove young virgin females to tank .., discarding all the Grey bodied females which might remain in tank 1. At this point all gold females are kept to ensure a good supply as sometimes gold and albino females prove difficult or impossible to breed and new females must be tried

As the breeding program continues, it may become obvious that one or more of the outcrosses are incompatible with the basic strain and do not produce good fish In some cases this can be overcome by merely carrying the breeding on for a few more generations, back crossing to the basic strain females each time. In other cases it might prove best to locate a different strain of the variant involved and restart the program for that variant

In case of the fish, in tank 5 the gold, bronze or albino) it would be advisable every so often to breed the select male to a gray-bodied female of the basic strain to create a stronger fish. It also may very well happen the the Multis in tank 8. when repeatedly crossed back to the basic strain, will gradually show higher and higher-percentages of fish with the basic strain coloration rather than the desired variant. If the fish are very high quality it would be worth creating a new tank to keep the females of the cross with which to breed future generations (by either deleting the least successful variant, or by pushing out the Wall s to add another tank!) If the fish is good quality but not outstanding, it might be well just to produce a new fish offering in color from the basic strain and beginning this portion of the breeding program over with the new variant

As the Basic strain guppies are kept as a pure strain. this breeding program is very flexible and any of the variants can be changed or deleted without affecting the other portions of the program. And, if by chance, you can have room for more than 9 tanks, additional basic pure strains can be set up.. Just think of the variations that could be developed!!!

Reprinted from Brooklyn Aquarium Society 3/70

HOW TO OUTCROSS GUPPY STRAINS

based on a program given by Midge Hill to S.C.G.A

We all know that the best advice one can receive (and follow) on how to breed show guppies is "..get a good-quality well-established strain and then keep it as pure as you can by inbreeding or .ine breeding.

Outcrossing is the opposite of inbreeding because it involves mating of fish that are genetically unrelated The reason that most successful guppy breeders outcross strains from time to time but seldom advise others to try it, is because outcrossing is really a form of genetic Russian roulette A successful outcross requires that the strains crossed be genetically compatible The odds against finding two compatible strains are very high

There are times however, when outcrossing may produce something that no amount of inbreeding with a strain will accomplish. There are times when your only alternative is to outcross for example, when you buy a fish at a show auction without a mate Fortunately, there are ways to improve your chances of getting good result from an outcross, how to pick the outcross strain, and how to proceed after the initial outcross to get the best subsequent generations.

Before getting into the good reasons for outcrossing, I want to mention that there are a lot of no-good reasons for outcrossing. Now there is nothing wrong with outcrossing just for the sake of idle curiosity, but it is wrong to pass these fish along as good breeding stock What outcrossing does is to scramble together the genetic patterns of the two parents, therefore, offspring from an outcross are genetically all mixed up.

Getting back to the good reasons for outcrossing, there are five situations in which outcrossing can be a good thing to do,

1. When an established strain will not produce a characteristic you want (a larger dorsal, perhaps because the gene pattern for that characteristic is not present in the strain.
2. When you are having trouble with and established strain, such as infertility, maybe
3. To produce big show hybrids
4. Necessity. .as in the case of a male purchased at a show auction with no female
5. To create your own strain.

Lets discuss each of these five situations in detail to explain why outcrossing, as chancy as it is, can be a good thing to do, and how to proceed after the initial outcross, because the breeding techniques are a little different for each type of outcross.

In the first situation, where you have a good established strain but you have been unable to get a certain feature you want by inbreeding or line breeding within the strain, outcrossing can be the solution. Lets say you have been working with a strain of reds which are not as bright a red as you would like. Dr. Lam has found that there are at least four different genes for red color. If your strain does not have all of these genes, no amount of inbreeding is going to produce what is not there to begin with. So, you will have to outcross to add the missing genes that are needed for a clearer, brighter red. Or, perhaps you have been trying to get a larger dorsal. You might be able through inbreeding, by careful selection of parents, to gradually over the years get a larger dorsal maybe. But there is a chance to use an outcross to pick up a larger dorsal in less time.

It goes without saying that you do not want to lose the fine characteristics of your original strain. So, while you are trying an outcross, you must keep your established strain going, not only to guard against loss of the strain if the outcross does not come out well, but also because you will need to have breeder from the pure strain to work with in order to incorporate the hybrids with the desirable added feature back into the pure strain.

What strain should be selected to outcross into an established strain when attempting to add a new feature to the established strain? First, the outcross strain should also be a well established one one that has bred true over many generations so that all the males in each litter look very much like previous generations. The outcross strain should be the same type as the strain you are going to outcross it to. In other words, outcross red to red, blue to blue, half-black red to half-black red, etc. And obviously the outcross strain must have the particular characteristic you are looking for.

When you find a strain that meets the above requirements as closely as possible, you make the outcross both ways. Take your best male, and mate him to females of the "outcross" strain and also take a male from the outcross strain and mate him to females form your original strain. You do this, because you do not know which way will come out the best and there is often a marked difference in results. And, of course, you keep the young separate so you can determine which way that has been most successful.

If you find a male in the first generation (the F-1) that looks like your original strain and also has the new feature from the outcross strain that you were trying for, well, you are just about as lucky as it is possible to be. What has happened is that the feature you wanted to pick up has proved to be dominant, and so it appeared in the first generation. When this happens, you breed this F-1 male back to females from your strain..... you want to work back into your original strain as soon as possible after making this type of outcross. Since the trait has proved to be dominant there should be fish in each succeeding generation that show the trait. The breeding program is continued by breeding the best male with the new added feature back into females of the pure strain that you have kept going on the side.

We have been talking about an outcross that produced the desired features in the first generation. Most outcrosses will not be so lucky as to show the desired feature in the F-1... but that does not mean it is not there. There are two reasons why a feature possessed by a strain used in an outcross may not show up in the F-1; a) the feature is recessive, or b). it is carried only by the females.

If the feature you want does not show up in the F-1 you should breed brother and sister from the F-1 litter together. If the trait is recessive, it should show up in 25% of the offspring from this sibling breeding. Assuming that the trait turned out to be a simple recessive and showed up in 25% of the F-2 you select an F-2 male that looks the most like your original strain which you have kept virgin exactly for this purpose.

The recessive trait will again go into hiding in the offspring from this mating, but all the young will carry the trait and by breeding a recessive trait back into an established strain which does not carry the trait, you have to use a two-generation cycle, every other generation you will breed sibblings and in the alternate generations you will breed back to the pure strain females.

You remember we said there might be another reason why a trait would not show up in the F-1. It might be that the new trait was passed to the F-1 females, but not to the F-1 males. Therefore, besides breeding brother to sister from the F-1 to see if the missing trait is recessive, you should also breed some of the F-1 females to males of your original strain on the off chance that the trait had been handed down by the outcross males on his X-chromosome... which goes only to his daughters. If this is the case it will show up again when these daughters are mated to either their brothers or back to the original strain males.. but in the latter case you are a generation ahead in incorporating this desired feature into your original strain. From then on each future generation is bred by mating pure strain males with females from the hybrid line which with each successive generation will get closer genetically to your original strain.

In summary, when an outcross is used to try to add a feature to an established strain, one of three things will happen in the first generation.

1) the desired trait is dominant,

2) it will not show up in the F-1 because it is recessive, or

3) it will not show in the first generation because it is carried by the females.

The dominant trait and the trait carried by the females are the easiest to handle. The recessive trait is more difficult. But in all three the whole purpose is to breed the new trait into your original strain as often and as soon as possible.

Now lets go to the second outcross situation. This is the case of an established, highly-inbred strain which has developed a major genetic flaw such as infertility, a high percentage of crooked spines, susceptibility to disease, etc. An established strain which is rapidly going downhill because of a genetic problem, but which is still beautiful in other ways, can sometimes be rescued by careful selection of breeders without resorting to an outcross. You would certainly want to try this first.

Let me say here that inbreeding guppies, even very close inbreeding, is not of itself harmful. Guppies will take close inbreeding for many generations without significant loss of size or color or vigor. When highly inbred strains develop serious genetic defects, and they often do, it is not because they have been inbred for too long a time, but rather because the breeder picked the wrong fish to use as parents.

But, what if your established strain just gets worse, no matter how carefully you try to pick the best parents, you can try an outcross. You should still try to keep the original strain going if you can, because you should bring back the outcross hybrids into the original strain as fast as you can.

You would use the same criteria in selecting the outcross strain as were used in the preceding outcross situation. Again, outcross both ways if at all possible, and again, keep the offspring from these matings separated until it can be determined which mating was most successful. When these F-1 hybrids are old enough to select breeders, breed the best male from the F-1 back into your original strain. It might also be wise to also breed one of the hybrid females to the best male available from the original strain just to see which method of breeding gives the best results. If the weaknesses start to show up again, back up and breed the hybrids sibling to sibling until the fault disappears again.

Perhaps I haven't said enough about why you want to outcross the strain to be a well-established true-breeding strain. Remember that what an outcross does is to scramble together the genetic patterns of the two strains which are crossed. If one side of the cross is itself only a few generations away from a previous outcross, all you have accomplished is to further mix up the genetic patterns. Long experience

and experimentation have proved that these hybrid-hybrids may look good for a few generations, but that their mixed up gene patterns soon cause them to regress back toward a small, motley fish.

Now, to the third situation in which an outcross can be desirable to produce big show hybrids. If you are very lucky and are willing to devote tank space to an endeavor with very long odds, you can keep trying outcrosses of two unrelated established strains hoping to find a cross that will produce outstanding results in the first generation. If you do stumble onto one of these compatible combinations that throw big beautiful - show specimens in the F-1, guard the two parent strains carefully.

One unique thing about this type of outcross is that there is no breeding program after the outcross. In fact, you do not breed from hybrids at all, but rather keep and inbreed both parent traits separately and outcross the two traits continually to each other to get your show specimens. Another advantage is that since you will not be breeding from these hybrids, you can discard the females as soon as they are sexable - no need in wasting food, time or space on them. The hybrid males are raised for show but are never bred either. Many breeders have used this method to produce their top show fish.

Another unique thing about this type of outcross is that often the strains that turn out these fantastic hybrids appear to the eye to be very inferior fish, but they are usually also very inbred.... For example, one highly successful outcross that works well for me involves using one strain of small veiltailed guppies that carry brilliant color to cross to a strain of big-headed, big-tailed blah-colored fish. The F-1 hybrids of this unlikely combination are large, beautiful, bright-colored fish which have won their share of international trophies. But, breed these F-1 hybrids together and all you get is junk.

Outcrossing by necessity is the next situation. Purchasing males without related females is the most common instance in which outcrossing becomes a matter of necessity. Having purchased a fish, you will need to decide what direction you want to go with him before choosing the female to outcross him with. You should decide what you like about him, why did you buy him in the first place? Was it his flowing dorsal, his color or what? Once you decide this you should look for a strain to outcross him to that is already well-established and which you think will best preserve the feature you bought him for. Almost without exception, the outcross strain should be similar in color, or at least the same basic caudal color.

For example, lets say you bought a green snakeskin male at a show auction. The best outcross strain to keep the green color would be a good green strain but it doesn't have to be snakeskin since the snakeskin pattern will almost always be carried by the male so will usually appear on all of the male young produced by the snakeskin, no matter what kind of female is used.

If the male you purchased was a gray bodied type you would probably select a gray-bodied strain with his same basic caudal color to outcross him to. If he is an albino a gold or a bronze he can be outcrossed to a gray-bodied strain. Although all of the F-1 will come out gray-bodied they will all carry the other body color which will show up in 25% of the fry resulting from a cross of two siblings from the F-1.

When you have selected your outcross strain, you should acquire enough breeders from that strain so you can keep the strain going pure in addition to making the outcross with the male. Because the best way to establish a strain from this lone male is to continue to breed the hybrids back into the already established strain. This is the quickest way to get the hybrid strain. With each generation the hybrids will get more and more like the established strain you are working them through. If you begin to lose what you liked about the hybrids in the first place start breeding the hybrids brother to sister.

The reason I do not recommend breeding back to the original auction male is that nine times out of ten you will know nothing about the fish. You do not know if he was from an established strain or if he is the result of a wild series of outcrosses. The chances are pretty good that he is a hybrid or not many generations away from an outcross. You have outcrossed him again, which makes his offspring hybrid-hybrids.

Breeding him to his daughters, in this instance, will just mix up the gene patterns even more. If you have the tank space, go ahead and try breeding his daughters back to him. You might get some show males, but to set a strain it probably won't work.

If that male you purchased was from an established strain, that is a completely different thing. In this case, both sides of your outcross were established strains. This is when you may successfully set a new strain by breeding him to his daughters, to his granddaughters, etc., if he lives long enough.

The fifth situation in which you must know how to set a strain after an outcross, is if you have the desire to create your own special strain. The idea of continuing, even very successfully, somebody elses strain just does not appeal to some people. If you are one of these, you can create your own strain. You would probably start by outcrossing a fish to a completely unrelated strain hoping to preserve the best qualities of each strain. Or a color mutation of some sort may appear in your own tanks and you might try to build a whole new strain from this mutated type. No matter how you start out, the idea is to purify the new strain as quickly as possible, and all of the principles already discussed apply equally here.

If you started with an outcross, breed the hybrid males to females from the established strains used in the outcross. If you were lucky enough to have well-established strains for both sides of the outcross, you can also mate the hybrid males to females from both of the strains used to see which gives the better results. If you started with a mutation through the pure strain females to set the mutated feature.

I think the half-black pastels have had more outcrossing done to them since they first arrived from Germany than any other type at the moment. Outcrossing of the H.B pastels was usually necessary because the Germans do not send females. This outcrossing has produced some beautiful fish, but a lot of the half-black pastel strains are deteriorating too. Not all of these outcrossed strains have continued to produce good fish generation after generation. You can not keep on outcrossing every few generation without finally screwing up the genetic patterns to the extent that the fish just deteriorate into a nondescript nothing.

In summary, first, outcrossing is not the name of the game at least not for very long. The real challenge of this hobby is to be able to set and then maintain a true-breeding strain which will produce beautiful fish generation after generation, show after show. And second, if you outcross, for whatever reason, dont put off these mixed up fish as being good breeding stock.

Condensed from "Guppy Gazette" Aug. Through Oct. 1973

VIRGINS

By Tex Bettes

Way back in the dark ages of fancy guppy development some respected old gentlemen with a twisted sense of humor, it wasn't Hahnel decided that female guppies should be kept virgins until mature. These virgin females were supposed to grow faster and produce better offspring.

In spite of evidence to the contrary this belief is held by many today. The most up-to-date articles on guppy rearing admonish the beginner to keep his females virgin if at all possible, and to buys only virgin females, even if it costs more. Every dime spent insuring that you buy a virgin female is a dime wasted.

The fact is that the first male mated to a female after she gives birth is going to father the next brood of young. The first brood will unlikely NOT be his, unless he was also the first mate but the record brood will (unless he is sterile) if he mates the female right away after she gives birth. This is easy enough. Just isolate the desired male with the female in question in your breeding tank before she has young. When she has them, the mate will be ready and willing to be the papa of the next bunch!

This can be proven by a very simple means. Take a male that you know from experience usually showing dominance in crossing experiments. Take a female from a recessive strain. Put them together alone. The first batch of young will be the strain of the female unless she is a virgin, the second will be exclusively fathered by the experimental male (unless he is sterile). The most a virgin female can do is cost you money, tank space and save you about five weeks waiting for her batch to deliver the young you don't want. Even if you pay extra, there is no guarantee she is a virgin.

Remember too, guppies can produce up to eight batches from one mating, so if she was mated with another male before she had all the young of the first, she might give babies from two mates in the same brood. Try this experiment. It is one of the interesting things about guppies.

Reprint The Glades 1978

WHY DON'T MY GUPPIES SPAWN?

by Jerry Albright

Guppies are normally prolific. They will spawn consistently with little regard to environment which other species of pisces require. But even the most advanced tropical fish breeder can be stumped when his pair of fancy guppies apparently refuse to spawn or deliver fry on a regular schedule.

When a guppy normally fails or ceases to propagate, there is usually a simple cause. Perhaps all that is needed is a feeding regimen featuring more live food. Another simple remedy for not spawning might be a partial change of water.

Excessive hormone treatment of females may be a common disability. If this is the case, little can be done except to replace the female.

Some breeders will dose a female, or in some cases a whole group of females, with male hormone. The object is to create a condition which will reveal hidden color characteristics. At best, the procedure is a calculated risk in an effort to determine the desireability of the strain of females before time is spent in rearing the first fry. One dose too much can sterilize. A few more can kill.

Under hormone treatment, females gradually begin to assume male characteristics other than color and pattern. Their organs begin to convert. The obvious outward symptom of organ change is the suffering of the anal fin into a gonopodium. If you notice this characteristic in combination with unusual coloration, don't buy the female.

However, don't be frightened off by high color alone. The female guppy of today is displaying more and more natural color.

While selection of males and females seems an elementary operation, young guppies may fool you. Possibly the simplest reason for a "pair" of guppies not producing fry is that you haven't acquired a male and a female.

It is known that some individuals mature sooner or later than others. So, a late developing male may be purchased by the novice. If you have purchased fish less than 3-4 months old, this may be the problem. The remedy, just be sure you purchase older fish. (Ed Jor's note: or make sure that one does not have a gravid spot.) I consider a good age for breeders between 6-8 months old. (Young females will have consistently smaller broods than older and more fully developed females. At the same time, fish much older than 8 months may have reached a time when they are slowing down and will produce fewer and more sporatic broods.)

Another cause of apparent impotence in guppies may be a nervous female. I sent a breeder female to a show and received back a nervous Nelly. She wouldn't let a male near her. And, she was large enough to defend her territory. For three months there was no activity, and when she finally did deliver the litter consisted of three fry.

The ideal remedy is prevention. Don't send a female needed for breeding to a show. If you do send the fish and she comes home nervous, try placing her in a tank with a larger ratio of females to males. She won't be hassled all the time.

There is one cause for no spawns which is not so easily detected. Nor is the remedy simple.

Regretably there is evidence that a few inscrutable boobs in the hobby and dealers are clipping the anal fin of males entered in shows. It makes little difference what the reasons are. They are all labor. The worst part is that some of these fish are offered for sale at the show auction. (This is not the fault of the show sponsor.)

If your fish are not producing check the anal fin of the male. While clipping is not permanent it may incapacitate the fish till old age takes over. Death from secondary infections may result. In any case observe your purchase closely before you lay out any cash. This should be a ground rule no matter where the fish are being sold (auction, show auction, shop, etc.)

The remedy is difficult. It means excision of a cancer in the hobby. The selfish and the poacher must be discovered and properly censured. It seems sad that a hobby with its primary objective in learning, and then assisting others in the hobby, can also support individuals as narrow minded and cruel as those who perpetrate acts such as this.

Guppies are normally active breeders and produce ample fry in regular litters. If this is not the case with your individuals don't give up. Check to see if the female has been damaged by hormone treatment. Buy fish which are between the ages of 6-8 months. They usually produce larger broods and are less likely to fool you by late developing sex characteristics.

In general, a show will frighten fish by all the activity and changes in water and other conditions. It is wise not to enter a fish in a show which is at all vital in your breeding program. When purchasing fish from an auction inspect them carefully. Be sure the fish hasn't been maimed to prevent functional breeding.

These are just a few of the problems which may cause unsuccessful attempts to raise and breed guppies. If you are having problems be sure and check these factors. If all these are found in proper order ask another breeder or a dealer you trust to have knowledge in guppy breeding. The solution probably is very simple.

(From *Dope-Topics* Great Plains Aquarium Society Dec.-'72

HYBRIDIZATION

LOOK FOR... PERHAPS WE SHOULD SAY THINK! BEFORE CROSSING

by Tom Hayes

One goal of every serious aquarist is to "***come up with something new.***" Certainly there is nothing more exciting than discovering that one (or several) young fish from a brood is different from its brothers and sisters in coloration or finage, and is perhaps the first of its kind. I'm sure many a hobbyist has had his experience and has envisioned himself as another Hahne (originator of the fancy guppy) or Simpson (originator of the hi-fin swordtail). I'm also sure most hobbyists with this experience have been disappointed for those unique creatures usually turn out to be undersized, sterile, or if they grow to normal size and are fertile, fail to produce duplicates of themselves.

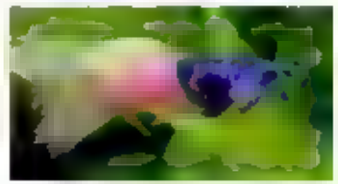
The kind of fish I've just described is a mutant, which occurs by change not by design. Well, then, why not try to create a new fish by design? Why not hybridize? After all!, won't this result in not one but many fish of a new color pattern or, finnage? The answer to this is "possibly" and only possibly. Furthermore, the result maybe disappointing. Before experimenting with hybridization to "see what happens" the following points should be kept in mind.

1. Crossing fish of different colors does not necessarily mean offspring sporting a combination of both colors. The genetic make-up of the fish determines the color, that is, if one color is dominant all the young maybe of that color although future generations will produce some of other colors.)

2. New hybrids often are sterile or of low fertility. A friend of mine developed a striking fish, but the strain has never been established as 90% of them have been sterile. This has been the fate of most hybrids despite the many beautiful strains of guppies, swordtails, platies, mollies that have been developed. And where established a hybrid strain has been successful, it was usually only after several generations of fish. So, even if a fancier is successful in establishing a new strain of fish, the entire process may take several years.

3. Not all hybrids are beauties. Is hybridization truly successful if the product is unattractive? A colorless or washed out fish certainly will not adorn your living room show tank. Neither will a local retailer be impressed with the uniqueness of an ugly fish that will not sell.

4. Experimenting with fish usually requires the use of a number of tanks as well as a number of fish. The beginning fancier, or the fancier with limited space, would do well to stick to the more mundane breeding combinations. Also, specimens for hybridization experiments should be as perfect as possible. (Flaws are going to be passed... forget it.) The fancier with limited breeding stock cannot afford to use his prime fish for experimentation.



THE WONDER OF HYBRIDIZATION

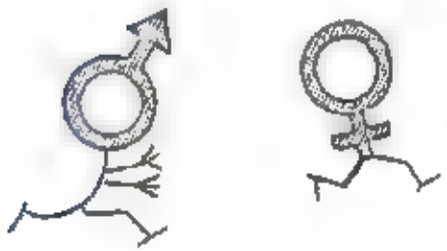
Anonymous

While hybridization has definite advantages, it also has disadvantages. In order to get one, you must resign yourself to the other. To my knowledge, there has been no quicker way invented to improve the appearance of guppies. Two poor appearing fish can be crossed together and the resulting young will be so unlike the original parents as to be unrecognizable. (Often the hybrids are better looking than either of the parent strains)

The method of outcrossing guppies sounds like the perfect method of getting good fish. which it is, provided you have two lines that will make superior guppies when crossed. The majority of crosses of two unrelated lines of fish will not be successful, meaning the fish will be poorer in physical appearance and possibly lacking in a wanted trait of the original parents. Another disadvantage is that the hybrids will not breed true in the second generation offspring. Often the young begin to separate out into mixed up versions of the original sires, each certain percentages...which makes them useless for all practical purposes of breeding, because the genetic make-up becomes so mixed up.

Opposite to the hybrid guppy is the 'inbred' kind, which have been bred together for some generations to concentrate certain characteristics. This also concentrates the unwanted traits so that after some period of time the highly inbred guppies may appear so poor as to be unwanted by people who do not know the fish for what they are. BUT the better the breeding stock is inbred, the better the resulting hybrid crosses are likely to be. The better hybrids are often made from very poor appearing strains that are specially bred for the purpose of creating hybrids.

(super condensed from "F.T.F.I. Trader", August 1967. Author not named.



DETAILS OF MY WORK WITH HALF BLACK PASTELS

by Elvis Bryant

THE HALF BLACK JOURNAL: AN INTRODUCTION

The half black guppies are a fascinating sight with their black bodies. And striking dorsal and caudal color. Shades of blue, pastel, green, red, purple,... Almost any color you wish is available through very careful breeding.

Through the years ever increasing numbers of half black guppies have been appearing in our shows. As a result, more and more classes are being devoted to the half black varieties. In some shows there are at least seven classes in the delta and veil. For example; half black red, half black pastel, half black blue, half black gold, half black purple, half black green and half black ADC (for any color we might have missed, or for any new color that might come along.) About 30% of each show is now being devoted to these great color strains, not counting the female classes. And, remember, the Black Class is a direct relation to the half blacks.

Remembering my first IFGA show at Indianapolis, I was greatly impressed by Bob Bohrer's half black beauties. Although I had seen half black reds before, I had never seen anything like these colors. Jerry Darnell, of St. Louis, had the largest half black reds I have ever seen and his famous strain win him acclaim throughout the United States.

But of all half blacks, the greatest thrill of my life had to be my first experiences with the half black pastels. In 1970 Jerry Darnell received a shipment of guppies from Germany for our show. Among the shipment were four of the most beautiful half black males with solid white tails and dorsals. In another bag was a beautiful half black male with flowing yellow dorsal and caudal. I knew right then that this was the guppy I wanted to raise.

HALF BLACK PASTELS: A BIBLIOGRAPHY (1970-1975)

Like so many guppies from Germany, no females of the original strain were available. So, using an assortment of females I proceeded to work with the half black pastels.

During the past five years that I have devoted to this fantastic guppy, I am still amazed at the new problems that keep arising. Using every imaginable combination of females, gold, yellow, green, half black, albino, red, and blue every way seemed blocked with problems.

The gold females, like so many others tried, were a great outcross. Fortunately, as with most outcrosses, there were advantages and disadvantages. The gold strain turned the good half black body color into nothing but a darkish green color with the body color near the head becoming a lighter shade of green. I ended up discarding these.

The yellow females proved more than a challenge. Good half black pastels were born, but in reproducing the hybrids the result was smaller body size and smaller caudals. I still believe that with years of work, the problems could be erased. Some fantastic pure color came from the yellow females, and at present I am still maintaining two yellow lines of half black pastels with some very promising males. It is not the first born hybrids that are important but maintaining and setting the strain for future generations through the years.

Using green females gave me the best Overall results. The caudal colors came out a very brilliant mint green. Additional breeding lightened the caudal colors in some to what would be called whites. These white pastels were the rage for a year or so, but black crept into the caudal regions, the white darkened, and the caudal color turned a blue-white. It took years to remove the black spots to regain the solid colors. The

green females, in my opinion, are a neutral color, and I was able to continue breeding several generations without loss of color although the peduncle area picked up a triangle of intense color. But all in all, using green females for outcrossing is a good way to produce good show guppies. But for some reason the pastels produced through green females do not seem to do as well on freshly hatched brine shrimp. It is best to separate the sexes so that the males can be fed more brine shrimp and the females less brine shrimp.

Using half black red females caused the red color to dominate the caudal color. These red colors were almost impossible to remove. The fourth generation finally produced a pinkish caudal but there is no way to control the color, which isn't even evenly distributed, but occurs mostly in blotches. It takes a great deal of patience to work on color when the results are so slow in developing.

Blue females proved to be similar to green but a bit more difficult. Remember, green worked as a fairly neutral color, blue did not. The offspring carried caudals that were more blotchy white on blue, but some males would show up carrying 70-80% blue along with the basic white. None of these hybrids reproduced males that would be considered show quality guppies, so this route was abandoned early in the game.

With albino females the greatest problem was finding fertile females to breed from. The 4-5 crosses I finally got were not very successful. The males were small with small caudals and a blondish head. This outcross attempt was also discontinued.

Basically I continued with the green and yellow females, although I believe that the various other females deserve more work before closing them out completely.

BREEDING THE HALF BLACK PASTELS

There are no unusual methods needed in breeding the half black pastels. Most true strains breed rather easily and are fairly prolific with the numbers of young varying from a first dropping of from 15 to 20, a second dropping of from 25-50. The third dropping is usually the largest, and from here on it would be best to refrain from keeping any more of the young as subsequent droppings from the same female would not be of that breeding to enable you to carry the strain into greater heights than the previous generation. Keeping larger quantities would just involve greater time and space.

In breeding the half black pastels I prefer mating the first and third generations of the same strain. These are usually half brothers and half sisters and are quite safe.

The other method is to introduce new blood through the selection of a good outcross female. This is only useful if your males are of good quality. If not, reverse the procedure, and use an outside male to your half black pastel females. The best, although time consuming, method when using an outside female is to locate a pregnant female from the best half black pastels available to you. Let the female drop her young and as soon as you can separate the sexes, remove the females and place them into another tank. Keep checking your tank to make sure no males enter this tank. This will enable you to cross either way female to your male, or male to your female...or, if the new strain is better than your stock you could just start over with the new strain and profit from past mistakes.

To avoid black spots in the male caudals it is important to select your breeder females very carefully. Pick your females for size and for clarity of color in the caudal region. In five years of experiments I have established the fact that females that carry an over abundance white, blue or any blobs of color will tend to pass these colors on to male offspring not much at first, but gradually the undesired colors will transfer to your males in greater amounts until you have no choice but to go outside your own strain to purify your color.

Another thing to be careful of is that males that have black spots will have a tendency to be larger and therefore appear more desirable, but these should not be used as breeders if you want to keep your color pure.

One way, which I found intriguing, to attain various color caudals is to cross a virgin half black pastel female with a 3/4 Black male. The results are something of a wonder and gave me the following colors: half black purple, half black blue, half black pastels of two shades...one of light blue and the other a darker blue and half black bicolors of a dark, forest green color. How's that for variety?

It is quite possible to breed these into set strains. The half black blue breeds to a 30% true strain with females being twice as large as the original pastel females, thus increasing your chances of entering female show classes. The greater color shows up in the half black purples. These will dominate in the offspring. Although these are very vigorous fish, the breeding results of the half black purples have not been good as the color of the offspring tends to return toward black and not a very good black at that.

In giving this detailed account of my work with the pastels, my main thought was to try to help others avoid my mistakes. Any comments or help from fellow hobbyists would be appreciated, of course. ##

ORIGIN OF NEW GUPPY STRAINS

by Tan Yew Chee

Take one of the many large, beautiful and fancy guppies that can be seen in the fish competitions today and compare it with the small, drab and common grain guppy. It is difficult to believe that these two are related. The fancy guppy of today has descended from the ordinary rainbow fish after many years of painstaking selective breeding by dedicated and hardworking breeders. But these people have been aided by a process which made it all possible, a process without which the guppy would not be so popular today. It is a process which gave rise to the large number of color varieties that this fish comes in today. This is the process of MUTATION.

A mutation is an unexpected change in the machinery of inheritance, in which one or more offspring turn out to be different from the rest. Usually the breeder does not expect this. For instance, he has been breeding a strain of black tail guppies for many years and all of a sudden he finds one fry which is completely black, including the head. That single unusual fry is more likely the result of mutation and is called a MUTANT. This must be distinguished from "throwbacks" in which the parent fishes are not actually true breeding and the young resemble one of the grandparents or great-grandparents.

The wonderful thing about mutations in guppies is that they happen quite often. Most breeders must have seen it in their tanks at least once. But a mutation cannot give rise to a new guppy strain unless it is "fixed", that is, the mutant must be able to mate and give rise to offspring that look like it.

Hence the other wonderful thing about guppies is that most of the mutations can be fixed, provided that the mutant is fertile. In "fixing" the strain, the mutant can be mated to his sisters or to the mother. If the resultant offspring resemble the mutant, the rest is easy. If they do not, try mating it to the daughters.

Most of the popular guppy varieties today, such as the Snakeskin, Black body and Albino, most likely came from mutations. They came about because certain breeders were able to spot them, and then fix a strain based on the mutants. The possibilities are endless. Mutations are all the time happening in the tanks of guppy breeders today. New strains with new color combinations are coming out all the time. So don't just sit back. Go and look at your fishes. You may discover one male that is different from the rest. That may be the origin of a new guppy strain.

(From Guppy Digest, Singapore Guppy Club)

A remarkably informative article by Dr. Eugene C. Larr which contains at least fifteen subjects...take your pick

DIFFERENTIATING COLOR
CONDUCTING A TEST
CULLING
KEEPING RECORDS
DELUSION
HOW MANY SUBJECTS MAKE A TEST VALID
TESTING LONG ENOUGH
A NEW FOOD
TESTING A NEW FOOD
MEASURING A FISH
KEEPING CAREFUL NOTES
FOODS FOR COLOR
THE BELL CURVE
BREEDING CROSSES
SWORDTAIL GENETICS

There is a rumor I am going to talk on the problem of blue and purple. Maybe I should make a few comments about that. What color is my shirt? What color are my slacks? What color is this notebook? There are some 22 recognized colors of blue and over 30 of purple. If they were all strung out on color cards and we had a hundred IFGA judges, and we cut out small dots from all of the color cards and asked the judges to put the dots in piles of blue and purple, guess what it would look like.

I'll leave that up to you people who have to judge to IFGA standards for blue and purple. Personally, I think we should put them together and save hard feelings and problems. Nevertheless, you have people who love blue and who love purple, and now we have lavender. What is the difference between purple and lavender? With paints you add white to purple to get lavender. Why don't we get into the argument, like is it orchid? Is it fuscia? I think we could add about twenty more divisions to these color classes. But let's get down to something we can do something about.

I want to speak on not only how you go about conducting a test, but how you are going to get information that is meaningful from that test. I am asked to evaluate test results, either of my own assistants who are spread everywhere from here to the University of Denver, as well as test results from amateurs. And there are three main things which will shoot a test down:

1. **Improper observation**
2. **Insufficient numbers of fish in the test**
3. **Not testing for a long enough period of time**

The first one is **improper observation** on your part. Remember, you are looking at these fish, you are arriving at a decision. It has to carefully done. Under this can fall three sub-categories.

The first one of these is not recording your culls. I have gone to fish rooms in fact, just this last summer I was visiting a very prominent guppy grower back in the middle eastern states, and I was looking at a "pure" strain of blues. I noticed he was busily fishing fish out of the tanks that had spots in their tails. I asked him what he was doing. He said, "Oh, these are culls. These are no good." Well, I asked him how many culls he threw out. He didn't remember. He just threw them out when they showed they were not pure blue. Please think about this when you are culling or classifying your fish. If you are establishing a pure strain, by definition we mean a pure strain. This means you are not going to have to cull for color. All of the males must be alike as far as color is concerned, otherwise it is not a pure strain of a particular color. There are probably only about 14 strains that I have lists on, that are pure color strains. Most all of the others show tremendous genetic segregation. So be careful when you record your results. You must record your culls and what you culled them for.

Another big error of observation that many, especially amateurs, make is that **they forget to keep their records up to date**. About the most horrible thing you can do is to examine your fish today and two or three days later remember you forgot to put something in your notes, so you go back and try to record it from memory. You cannot do it. And never erase anything from your records. If you later feel it should have been evaluated in a different way simply cross out and write in the new evaluation. Don't throw out that original observation, it might be of extreme importance.

One failing that all of us have and nobody wants to admit is **delusion**. It is so easy to look at your tank and say, "Oh, I have a hundred super blue delta guppies." Then, you start picking them out, and you find.... well, that one is not quite as good as I thought and neither is that one. Suddenly, show time comes and you decide you really don't have a single fish that is worth taking to the show. That was because of delusion. Don't get into that trap. Only you can keep yourself out of it. As I say, it takes a real firm grip on your imagination to see a fish as it really is; not as you think it might be generations from now or maybe when it grows up a little. **Look at it just as it is.**

Another common failing in testing, especially in tests in genetics, is using an **insufficient number of fish for the test**. This has shot down more genetic studies than any other single factor. Remember, when you are doing a genetic test you must have a test group and a control group. And, please, try to have at least 100 males from the same cross before you even start guessing about what is going on genetically. In all the genetic tests we have done, we have tried to go to 500 male fish. If you wanted to really pay attention to the science of genetics itself, you should only evaluate genetic traits on about 40,000 fish. Now, of course that is impractical under most conditions, if only because no female is going to live long enough to do it. We have found, however, that if you drop below 100 you are in real trouble, and at 500 we got results that could be duplicated. So somewhere between 100 and 500 is the bracket to work in.

On many other kinds of tests the third failing that usually knocks down work is **not testing for a long enough period of time**. You must carry all feeding tests through two generations. You must carry all genetic tests through from three to six generations. The biggest pitfall here is jumping to a conclusion before the test is finished and stopping the test. This can be a very big mistake. I argued with a gentleman extensively one time when he said he had a pair of fish and the female dropped some 50 babies, but the next time she dropped, the babies turned out to be quite different from the first litter. So I said, "What did she drop the next time?" He said, "Oh, I threw her out. She was obviously no good." Well, that guppy had a chance of producing who knows how many thousand genetic combinations in a single litter. That little female had not changed her genetics, segregation had simply taken place along genetic rules. If he had saved them, so we could count them and plot them on a curve, we could have found out what she was really doing

I am going to digress here for a moment and talk some more about culling. This is probably one of the biggest mistakes that amateur and proffessional breeders both make. They cull their fish too young before they know what the fish really look like. Many breeders will tell you that the slow growing males turn out to be the most spectacular. As a generality, this is nonsense. I have even heard, and it was quoted in one of the guppy magazines, that you should never keep more than the first twelve of a litter. That is pure stupidity. That is like saying that if you are going to have six children, let's kill all but the first two. But people won't look at it that way. They say the first 6 or 8 or 12 (or whatever figure they want to use) are the strongest because they were closer to the sperm. It doesn't take much zoology or biology to know that is absolutely wrong. So, please don't do it. Save all of your fry, segregate them as early as you can if you are interested in virgin females, and raise them all to maturity.

How many of you, now be truthful, and I will raise my hand first, have at home a tank you call your cull tank, into which you throw miscellaneous babies? And, four months later there is the most beautiful fish you ever saw in your fishroom....in your cull tank. Now you have a big problem. Which of the twenty tanks did he come out of? Well, don't do that. I know it takes a lot of room. It takes much space to raise all the young in a litter, but you really must do it.

Some people will cull out baby males from a delta strain because they do not have a particular shape round tail when they are babies. In a particular purple strain that I know of, this is true. The best delta males will have tails shaped like round buttons when they are babies. So, maybe you could cull that strain this way, but unless you know your strain very very well, don't do it.

Now, let's get back to the problems you bring upon yourself when you do not continue a test for a long enough period of time. Let's take this business of making feeding tests. Let's say you found, or have dreamed up, a new guppy food. Incidentally, and I am digressing again, but we have dreamed up a new food that looks like it is going to be a super one. You all know my earthworm mixture, where you stuff a blender full of earthworms and turn it on. It's a mess to make. (For you married men, don't let your wife catch you doing this in the kitchen blender.) With this new combination you have an even bigger problem. You all know the little meal worm a brownish worm with a hard cover. Inside of that little meal worm is an almost perfect balance of enzymes. It is an almost perfect combination. So, all you have to do is cut off their heads, squeeze their insides out and add this to the earthworm mixture. We found an even better way to do it, is to slit the meal worm lengthwise, open him up and scrape the insides out. Some of the connective tissue inside the meal worm seems to be very vital. I don't know how we can mass produce this, but it is making some very phenomenal growth. I feed my fish three times a day, and I now have fish that are almost twice as big as they should be after feeding them this earthworm meal worm mixture. It is a headache to make, but it is doing something that they like.

OK, how are you going to test a food? In order to test this earthworm and meal worm mixture, I chose a particular strain that I have, simply because the females drop lots of babies. I let a female drop two litters, which gave me over 200 fish. After they got used to ordinary eating....brine shrimp, etc....I divided them in half and put them into two 20-gallon tanks. One tank was then fed the ordinary diet, which is earthworms, beef heart and a combination of several dry foods, three times a day. The test group was fed the new mixture of earthworms and meal worms, beef heart and the dry food mixtures. This test group was also fed three times a day the same as the control group.

You keep doing this and go, and go, and go, and go, and don't cheat and don't forget. Keep the two groups separate, so you don't end up feeding the wrong group. Make sure the test tank and the control tank are sitting at the same level in the fish room, make sure both tanks get exactly the same amount of fresh water when you change water, make sure they both have the same amount of plants (if planted), make sure they receive the same amount of light. All of these things enter into it. You raise these up until they are

mature, and then breed every female from both the test tank and the control tank, count all of the fry from all of the females to see if there are a greater number of fry from the females fed on the new food. If so, it is a good indication that you have a good food.

On a feeding test you should carry even one step further. I have received only a single report, from Dr. Edwards in Germany, where testing was carried to the F2 generation continuing with the same food. This is extremely important, because while the mother fish carrying the young is eating the new food, you might have added something that would affect the babies. So you have to go through the F2 generation, raise them up, and see what they look like. That is where the deficiencies will show up.

I am very suspicious of the unusual, sudden disappearance of strains when they are fed a certain food, maybe only one food or a couple of foods and suddenly it is noticed that fertility is falling off at an alarming rate.

If you are outcrossing to produce your show fish, and you are certainly going to feed these show fish more than three times a day, and you are going to have the temperatures higher and all of that generally you do not care if these show fish are fertile or not. You are going to be raising the males to make them as big an heavy as possible, I would certainly recommend this new food mixture for that. Even as far as we have gone, the results are quite spectacular. I do not know as yet its effect on the females or on the females young. We will not know that for about another six months.

When you see a new food on the market, don't take it home and sprinkle it in your tanks and say, "Yes, the fish look bigger than they did", because you do not really know. I am not being critical, but even if you know your strain very well, don't jump to these conclusions.

How do I know my fish are bigger than their comparison tank? I know because we measure them. We take them out of the tank, we hold them on a millimeter board, and we see how long they are. You would be surprised, after you have measured the same fish about eight or ten times he gets quite used to being measured. I don't know if he realizes what is going on, but the first two or three times you catch him and lay him on the millimeter board, he flops around and has a gay time. But after eight or ten times he lies very still, holds his breath, closes down his gill covers and just waits until you make a note of the length and plop it in back into the tank.

So, when I say that the fish in the test tank to which a new food is being given are larger than the control tank, I can say this because they are 22 millimeters longer. Two-and-a-half millimeters sounds small, but you would be surprised how much bigger they look. But you have to measure them to know for sure.

We are also running rates of growth curves on this new food. For instance, what do you look for in a food? Rate of growth, age at maturity, how fast they go into old age, how soon they die. These are very critical figures. You should keep careful notes on these things for your records. Write it down.

If you have a strain of fish that has been fed a certain food, and they reach maturity at 14 months, and by 18 months their tails are all shot, try something else. Maybe the food they are getting is not enough to sustain them that much longer. I am very concerned, for instance, with the green strains which are notorious for having small numbers of young. I think we have some interesting things to explore here, and it is something all of you can do. These kinds of experiments on feeding really need to be done.

When you see an ad, that a fish was fed such-and-such food and became the grand champion at the Berlin show. Well, you and I both know that fish was not fed just that one food. He was fed a lot of other things. It wouldn't take you long to find out, if you fed your fish just this one food, that something else is needed. The beginner does not know this.

R ght here I might tel you about another ittle test we have been doing Remember the comments in some of the loca papers about the feeding of marigo ds to chickens to make their skin more yellow so they wou d ook better in the market? It works w th guppies, too. You can change them anywhere from ye low to a deep, almost maroon, orange that some marigold flowers have Th s shows up most obviously when using albinos. You have one major problem, however Some guppies simply do not l ke marigolds, They w ll not eat it. Using six males and five females from an albino strain, I started feeding them air-dried marigo d flower petals along with their dry food. They wou do t eat it So only fed them twice a day and then offered the marigolds again they sti wou dn't ea it, So I did not feed them at all for three whole days, then offered the marigo ds, and then they ate it So you sometimes have to go through the back door to do some of those feeding tests.

The yel ow color from feeding marigold petals seems to last qu te a long t me, so beware If you see a female albino with a bright orange dorsal and cauda, (the change in body color is n ormal) be suspicious that someone has been using chemistry instead of genetics. If you want to try it; plant marigo ds now. When they bloom, pul the petals off, cut the tiny white tip off the bottom of each petal let the colored part dry in the sun, scrunch this up into very smal bits and feed it to your guppies. If you have a strain that l kes marigolds, they wi l color up quite fast If your strain doesn t like it, you wi l have to starve them to it

Question from the audience: "I have red fish Do I have to go home and plant red marigo ds?"

There aren't any red marigolds, so you would have to feed your red fish paprika or someth ng very high in carotene not carrot juice, but carotene

Question from the audience: "Won t carotene turn a red fish brown?"

It depends on which you are using. There is carotene A and carotene B

C arotene B wi make them kind of a burnt orange

Question from the audience: "Isn't carotene the main ingredient in High Gro 30?"

I th nk they are also putting in the carotene that comes from the she ls of shrimp Those seafoods that turn pink when cooked are h gh in carotene....carotene A That s the one you wou d like to get your red guppies to eat, but in the case of the shrimp, t is locked up and the guppy can't do much w th t, and I t is broken out chem cally Just l ke when you read the labe of a food can showing so much protein it depends on which protein it s. You have al seen that silly shampoo commercial about your hair being protein Be leve me, if you chop up hair and feed it to your guppies they w l starve to death Even though hair is protein, there is no way for them to get it out. Th s is where you get into the problems of advert sing and fa se advertising. You have to try these things yourself, but give them a real try. Don't come to any conclusion after just a few feedings

Now et's take one of the genetic ones, You are a l raising w de tai ed guppies, and you all cu rather ind scriminately Don't do that Don t cul any fish until he is mature. I' l tell you a real special reason why This itle curve is called a bel curve In this example, we have the number of fish on the vertical axis and cauda w dth on the horizon a axis.

For each itter of your wide-tailed guppies you should draw a chart ike this. And you should be very critical. You are the observer You are the only one that can do it. The important thing you want to watch, generation to generation, is wh ch way the bel curve is mov ng. Are you getting more or less males in each generation with really wide tai s?

A l of you have raised wide-tail strains, and maybe five or six in a itter were spectacular. So you threw out the others. Well, those five or six super deluxe represent just a itt e piece of your bel curve. Meanwhi e all the rest of the curve is in the genetic background of your super fish If you chart your fish generation after generation and begin to notice that your bel curve is moving to the eft showing smaller numbers of fish with extra wide tails, you are in trouble. If the peak of your bel curve is moving to the right, great you're doing the right th ng. Unfortunately there is no way to guess about this. If you look at a whole tank of fish you wi see a l kinds of tai widths. Maybe you guess that half of them are good and about half are not wide enough But this sort of guessing doesn't tel you unti much too late, that your strain may not be producing as many wideta ls as it did before.

You can do the same sort of th ng for dorsals A lot of people do have trouble gett ng and keeping good dorsals. With every sing e male fish, when he is mature plot your bel curve with dorsal ratio or dorsa length, whichever you are working for I have known people to start with a strain that had a very f ne dorsa, a swordta l strain, for instance that had a dorsal a most as long as the cauda fin. They thought they cou d eat mate their breeding res ts, but sudden y they had lost their beautiful long dorsal It did not happen suddenly at all It happened while they were not paying close enough attention. The bell curve wi l enable you to spot this sort of thing while it can be corrected

There are three ways of breeding guppies, siblings, ine crosses and outcrosses. Keep careful records on outcrosses. Remember outcrosses should be made in both directions whenever you can do it. Mate male from strain X to fema e from strain B, and male from strain B to female from strain X Because you do not know from which d rec on you are go ng to get the better comb nation.

Sibling crosses are mat ng brother to sister, as I am sure you are al aware, though I am amazed at how many mistaken ideas are floating around If you mate a female and get a itter of fish, and about a month later you get another itter from the same parents, both litters are sti the F-1 generation. You designate these itters as F-1/1 F-1/L2 etc They are a l brothers and sisters even if they might be born a year apart

In line breeding you mate an orig nal set (male and female) then mate two sets from the F-1 generation and keep breed ng brother x sister in two l nes, which as they move away from each other in distance, become more and more unrelated

I th nk the misunderstanding that is most fascinating, and it never real y dawned on me that people would mis nterpret it, is the ha f-sib ing relationship Let's say you have a male fish that you bought at a show auction and you want to mate this male to something To keep this clear in your mind we' l call h m Jack, and the two females you are going to mate him to Jil and Dorothy So you put Jack with Jil, and Dorothy and they both have babies. What is the relationship between Jil 's babies and Dorothy's babies? The two l tters are ha f brothers and half sisters to eac other Both had d fferent mothers but the same father Many books cal this a cousin relationship, but, of course, it is not

To make cousins you have to get Jack's brother we wi ca him Hal. If you mate Jack to Jill and Hal to Dorothy, now the resu ting litters wil be cousins to each other The on y reason I am mak ng such a point of this is that it is important to realize that both itters from the Jack-Jill and Jack-Dorothy combinations are ampl fying the traits of the male Jack. If you then cross these two, you are mating ha f brother to half sister and therefore recombining the tra ts of the one male. You w l be surprised what you can do, with this sort of th ng.

I have been raising guppies for a long, long time. I have frozen in little blocks of ice, guppies that were really spectacular back in 1945. You begin to really understand the comment you hear at every guppy show. An older person will say, "Are those really guppies?" They remember the little, short, gray-bodied fish with blue and red dots that we have been working on so very, very hard.

I am sure you have all been following the discussion on swordtail genetics that has been going on in the AFGA Journal. We have an acute problem there. I know part of the problem. One of the basic tests to check a Y-linked trait is to outcross to a strain that does not have the trait in question. In other words, if I have a swordtail male and out-cross him to a female from a wild gray strain that has had a round clear tail for 18 generations and this cross throws no swordtails, then the swordtail trait is not on the Y chromosome. If this cross throws all swordtails, then the swordtail is on the Y. But can you imagine testing for a swordtail Y-linked trait by crossing to a veiltail female? **All veils and all delta have swordtail traits every single one of them.** So if you outcross any veil or delta to a wild gray, you will get swordtails... top, bottom and double... all over the place. **When you make an outcross to test for a genetic trait, make it to a fish that does not have the trait you are investigating.** I do not mean a fish that just doesn't happen to show the trait. I mean one that does not have the trait.

You folks probably are not doing many of these kinds of outcrosses. Not many of you will take your pretty show fish and mate them to a crazy little wild fish only an inch long with a clear tail. But if you did, you end up knowing a lot more about genetics, and you would have a great deal more appreciation for how complex that fancy fish really is.

(from a lecture given at the S.C.G.A. meeting and transcribed for the Guppy Gazette, April 1973)

ANOTHER VIEW OF INBREEDING

by Jim Keith

INBREEDING: To state that inbred stock degenerates on the one hand and on another breath claim that crosses between separate strains produce strong, vigorous offspring seems a contradictory mass of facts. The curious, and at first sight, lawless statement comes from one section of Biology that in recent years has thankfully been swept clean and put in order by hard-working Biologists unsatisfied with the old state of affairs.

Their findings showed that the relative-merits of inbreed and outbreeding will depend simply on the recessives which that particular strain in question is carrying. If these were harmful, then to inbreed with them will cause a multiplicity-of faults, but outbreeding may produce good results. If they have desirable recessives, then the opposite will prove true.

(Excerpted from "Guppy News" Vol. 1, #8)

CHERCHEZ LA FEMME...

by Bob Fisher

Perhaps one of the most difficult problems which faces any guppy hobbyist is choosing the right breeders for future generations. Selection of the correct parents for the next brood is essential to maintain an existing strain, or to improve and build up a new strain. Now this is not an easy task for even an advanced hobbyist, but for a newcomer or novice it is difficult and very often a hit or miss proposition. Many fish having good potential breeding qualities have been overlooked by beginners simply because they have never been instructed precisely as to what to look for among their breeding stock in order, to improve their strains.

Now I do not believe there is any magical formula to follow which is sure to spell out success time after time, but I do think a few pointers on the subject may be a help to those in doubt.

When I started breeding guppies a few years ago I was completely in the dark about this and lost several very promising strains of fish by degeneration. I just didn't know what to do to preserve color, or size, or tail spread, so instead of improving, my fish gradually deteriorated until there was nothing left worth keeping. This sad experience has happened to most of us at some time or other, and when we look back now we are able to see the mistakes we made. My mistake was in breeding for color alone, giving absolutely no thought for size or shape. Consequently I soon had tanks full of beautifully colored midgets.

Nobody can accurately predict the outcome of a specific mating, but if we know the recent past history of the fish we are breeding with, we can have a fair idea of what we may expect. All other factors then being equal we get our brood of youngsters, raise them as best we know how and sit back to anxiously await the outcome.

Time is the biggest factor because when we have committed ourselves to breed a specific pair of fish it takes about three or four months before we can have some idea of the outcome. If our choice of breeders has been wrong, we have to go back and start all over again.....but as most people find out it is often too late by that time as the original breeding stock is no longer around. So it is very important that we not only choose the right breeders to begin with, but use enough pairs to guarantee several batches of young from which to choose the best.

In the choice of our male breeders, we obviously pick out the male or males whose total qualities rate highest on the scale. For instance, we choose males having the largest size,widest tails, heaviest dorsals, brightest and purest colors and most vigorous deportment. The choice is not too difficult as these fish stand out among the rest. The qualities we are searching for may exhibit themselves in only one fish or in several but without question these are the fish that should be carefully preserved for breeding purposes. Each and every male fish should be carefully examined for minor defects and their pros and cons assessed until the choice is narrowed down to the few fish having the most promise.

Guppies have a habit of mutating and statistics show that as many as 10% of all guppies are mutants that is, there has been some genetic change in the basic gene structure, which has or will produce some new feature or characteristic in our fish. This may show up as a visible change, but often the change is not visible so that a mutant can go undetected for a long time. It should be remembered that at least 95% of mutations are detrimental and indicate deterioration or degeneration of the strain, therefore we must constantly watch for those mutations which are detrimental and be careful that we do not allow these fish to become breeders, for this will pass on the trouble to the next batch and finally destroy the strain. By the same token, however, we should constantly be watching for beneficial mutations which are able to improve our strain. A beneficial mutation may be the sudden appearance of a fish with exceptional qualities... a huge

body, a much wider tail, or a new color pattern - in fact, any new quality which makes it different and better than it's brothers.

I constantly watch for these fish, and if they promise to improve a strain I use them to improve that strain. This, in the choice of breeders, observation is one of the most important factors. I might say right here, if in doubt, wait a while longer - even as much as a month to be really sure of your choice. Choosing the best male fish of a batch indicates his potential contributions to the future generation. He is the living custodian of the gene package which produced him and is therefore capable of transmitting this same gene complement to the young he will father.

Having a male fish all picked out, we now need a female to go with him, hence our title ***"Cherchez la Femme"*** It is my personal belief that the most difficult choice of a fish in picking out the female of the breeding pair and it makes the job of picking out the male sheer simplicity by comparison. The trouble lies in the fact that there are only limited ways and means of finding out what our gal can contribute to the mating. As already stated, recent past history of the strain is a good guide in the selection of a female. Color proving with methyl testosterone (male sex hormone) can be helpful, but could sterilize the female. So about the best we can do is again carefully observe our batch of females and look them over for size, shape, condition, color and deportment, then on the basis of elimination pick out two or three which are better than the rest.

This still doesn't mean we have made the right choice, but we have narrowed down the odds considerably. With nothing else to go on we have at least singled out a few fish which possess size to help eliminate the runts, shape to help eliminate freaks and deformities, and health to ensure strong, healthy offspring. What remains to be done now is to breed these two or three females to the males of our choice and raise each batch of young seperately. If the improved features we are looking for fail to show up among the youngsters, then we must try another three females to the same male and so on until we find what we are after or until we run out of females.

It was our friend Pete Hutter of Cleveland who explained it to me this way: "In every batch of young fish there should be a male with the ability to improve the strain. He is generally quite easy to spot. There is also a female with the same ability...however, she is not so easy to spot, therefore it may at times be necessary to breed every female in a batch seperately in order to find the right one." Picking the three females best for size, shape, health and deportment etc. has the advantage of shortening the search, because the best breeder females usually have these desirable qualities.

Now a few other random points. I have found from experience that too much inbreeding will cause degeneration of a good strain. This is demonstrated by smaller size, higher percentage of runts and cripples, and greater susceptability to disease. One runs into these problems when breeding brother to sister, son to mother, and daughter to father. Some in-breeding has to be done in order to "fix" a strain, but I try to stay away from it as much as possible. Breeding cousins or second cousins permits you to stay within a strain and maintain some hybrid vigor and thus you resort to inbreeding only when necessity demands.

It has also been noticed that the same female may drop several batches of very good babies and then suddenly switch around and begin delivering poor ones. The only explanation could be deteriorating health or some unobserved malady having it's effect. This is why I feel it is essential to keep every batch of young separate until they can be evaluated, accepted or rejected. Never try to raise every batch of young to full maturity. **Rear only the best and cull the rest.**

The most often repeated mistake made by novices is to breed for color only. Try instead to breed for size and shape first, worry about color only when you have a strain delivering consistent size and shape. When you choose a male breeder observe closely the body shape. If he has any slight spinal bends, or a

thin, narrow peduncle region, if his tail is uneven with elongated or retarded rays, if his dorsal color fails to match the tail color, if he swims with a pronounced wobble, if his belly is bloated or punched or is his aft end hanging or droopy, don't use this male as a breeder. Chances are that he will pass on these defects to his offspring. Some of the defects noted are hereditary, some are caused by poor environment or diet, but none are desirable, and breeder males are required to have healthy, vigorous deportment. The same advice goes for the gals also, but unfortunately with females some of these defects are pretty hard to spot.

Another tip Pete Hutter gave me which I pass on, "In choosing female breeders, go for those which have, short, thick, stubby bodies, wide peduncle regions and widest tail spread. These females produce the widest-tailed male offspring." I can't argue with his viewpoint because his females have the thickest and deepest bodies I ever saw and the tail spread of the males of the strain is superb.

Of course every strain of guppies is different, but allowing for individual strain peculiarities, the best and widest-tailed males usually come from short, deep, stubby, wide-tailed females. Jim Kelly of Great Britain reports most success with "Superba" females. I have had better luck with "Round tails". This should not be taken as indicative that all females should be either "Round Tails" or "Superba" in order to produce very wide males, rather to demonstrate there are always two ways of skinning a cat.

Next, don't change horses in the middle of the stream. Don't become impatient and start switching males and females half way through a breeding cycle. Stick with your original choice and see it through. If you must switch, do so only after your female has delivered her young. Chances are very favorable that the new male will take over and will father the next brood.

Unfortunately when you purchase a pair of fish you must, of necessity, use them for your original breeders. If they happen to be brother and sister you are forced to inbreed - maybe as many as two generations. Draw your own conclusions about the possible outcome. A wiser idea would be to buy at least two pairs of breeders in order that the second generation may be bred from cousins of the first. I have known some breeders who carry as many as four lines of the same strain for this very purpose.

Remember this, the goal of every guppy breeder is to originate and improve his own strain of fish. Experienced breeders know that there is no short cut way to achieve success. Careful choosing of breeders is a major factor in the quest for the perfect guppy, and attention to detail in this area is of extreme importance... Lady Luck plays a part also, but the breeder himself is the controlling influence. Time and care taken in choosing the parents of the future generation pays off! large dividends when we have the proud swimming around in our guppy tanks, and our own fish are awarded ribbons and trophies. I would wish that the task of picking our breeders would be easier, but then if it were, there would be little challenge left in breeding this fabulous little fish.

(Reprinted from "Guppy News" Vol. 3, #10, 1966)

BREEDING TECHNIQUES

While there are a great many different views and methods of breeding guppies, all of which have worked for somebody, there is also a great deal of basic agreement on the generalities of successful guppy breeding. Breeding guppies is such a wide subject that several bulletins could be filled with articles on this subject alone. In this section we are "bringing together" some of the best that has been published on developing, maintaining and improving pure strains of guppys by means of inbreeding or linebreeding methods, and developing new traits through mutations.

THE NAME OF THE GAME IS FANCY GUPPIES

by Norman Brinsenhar

If you appreciate truly exotic fish and enjoy the excitement of a game that challenges all of your skill, knowledge, cunning and luck, then the name of your game is "fancy guppies". It's as much of a gamble as Las Vegas, and while not everyone wins, at least there are no real losers. But the game is not as simple as it might first appear, and you may be assured that Mother Nature operates a tougher house than any of the casinos in Las Vegas.

It may help to understand just a few of Mother Nature's house rules for the game. First, it takes a combination of two recessive genes to express themselves (Phenotype). Second, most of the desired characteristics that separate the beautiful fancy guppy from the common wild guppy are recessive. With this in mind, assume for the sake of simplicity that each of five characteristics that you desire (i.e. large body, delta tail, large flowing dorsal, clear rich blue caudal coloration, and uniform blue body coloration) is controlled by a single gene. Assume further that your selected breeding pair are both heterozygous (have one dominant and one recessive gene) ratio each of the desired characteristics. What are your odds of getting all of the desired characteristics in a single male out of your first cross? Would you believe odds of 2,048 to 1? I warned you it was a tough game. Now, assume that each of the desired characteristics are the result of a combination of at least two different recessive genes (*most of the above characteristics are known to be controlled by multiple genes*), what are your odds of getting all five characteristics* "in a single male" A mere 34,554,432 to 1! Now you know how really tough Mother Nature can be.

Before you despair, let me hasten to tell you that the game can be played with loaded dice. They will not allow you to win every time, but they will give you a good fighting chance. The name of the loaded dice is breeding stock that has been closely inbred for several generations. With close inbreeding on a selected basis some of the desired characteristics will be homozygous (both dominant or both recessive), so you have really changed the characteristics of the game entirely. With some assurance, but, as to the homozygous characteristics that you will receive constant results, you may now focus your attentions upon fixing the other desired characteristics in your strain.

Assuming the strain for which you select your breeders are inbred, you come to the problem of selecting the male. While you can see the characteristics that some of his genes will reflect, the selection of this fish will be basically a matter of compromise. For the reasons stated no one fish is likely to have all of the characteristics that you desire. Look at his brothers and find out as much as you can about his father and grandfather. If they have some of the missing characteristics you are ahead of the game.

Now comes the wild card in the deck. The female shows little indication of her genetic make-up. She should be a sister or close relative of your selected male, but beyond this there are no hard and fast rules, and I will merely pass along some of the advice that I have received from expert guppy breeders. If you have mentally picked the longest and biggest female in the tank, well don't. The smart money is riding on the short, stubby fat gal. I know that the largest female that I have ever owned threw off the smallest males and the stubbiest female I have owned threw off my largest and most elegant males. I have compared notes on this observation with several experienced breeders, and all concur in the selection of the short fat gal.

There are a number of theories being popularly advanced that the shape of the caudal of the female gives some suggestions as to her genetic make-up. I can neither confirm nor deny any of these theories, but will pass them along for what they are worth. A recent survey done on the West Coast would suggest that of the three basic tail types (round, box and shark), by far the largest number of delta males were produced by females with round tails, followed by box tails, and shark tails placed last. On the other hand, the famous breeder and author Larry Kolng uses only shark tails. Another well known breeder looks only to the height of the tail, and still another looks for the angle of flare in the tail. Most concur that in the 1/2 and 3/4 black strains that the shark tail is the preferred selection. It would appear that the results vary from strain to strain and that experience with a particular strain will give you the best indications. If you have no such experience, select a round tail with the greatest angle of flare and height.

With the advent of the modern fancy guppy a number of color strains have females which show color in their caudals. In the red strains there is usually a substantial dark area with some indication of red, blue, green or yellow. For clear, bright red coloration in the male, yellow is the suggested choice in the female according to the "smarts". Probably the first color strain to show coloration in the tail of the female was the blue strains. Good blue coloring in the tail of the female is the desired choice. With greens most of the tails will be clear, and results will depend on individual strains.

One last word. With inbred stock your first cross will likely produce no dramatic results (and no nasty surprises, either). However, you should end up with a number of high quality fish and hopefully, some should be better than their father. At any rate with selective breeding you have a splendid chance to really improve your strain, AND THAT IS WHAT THE GAME IS ALL ABOUT.

(Reprinted from Fish Fancier 1969)

LINE BREEDING

by Joseph L. Tuppler, Jr.

When the subject of linebreeding is brought up, most fanciers regard it as the breeding of closely related fish which come from parents exhibiting desired traits. At most they will have some appreciation of the need periodically for crossing their strains with like fish from other fanciers.

There is more to it than this. Proper linebreeding not only allows the breeder to maintain a desired strain and to fix new types which crop up, but also if coupled with some knowledge of trait inheritance, to develop new strains or improve old ones.

Select the two best of your stock and breed them back to their parents, mother with son and father with daughter. This fixes your parental lines.

These two lines are not to be bred with brother/sister crosses using the best pair from each successive generation for from four to five generations. How many inbred generations you can use without weakening your line depends on how robust your stock was to start with and what mutation rate you experience. Each generation must be culled ruthlessly to only a few pair, and the best male and female mated for the next step.

After your line has been inbred for four or five generations, you select your best pair from of the two lines your original breeding gave you, and you cross between the lines, the male from one line with the

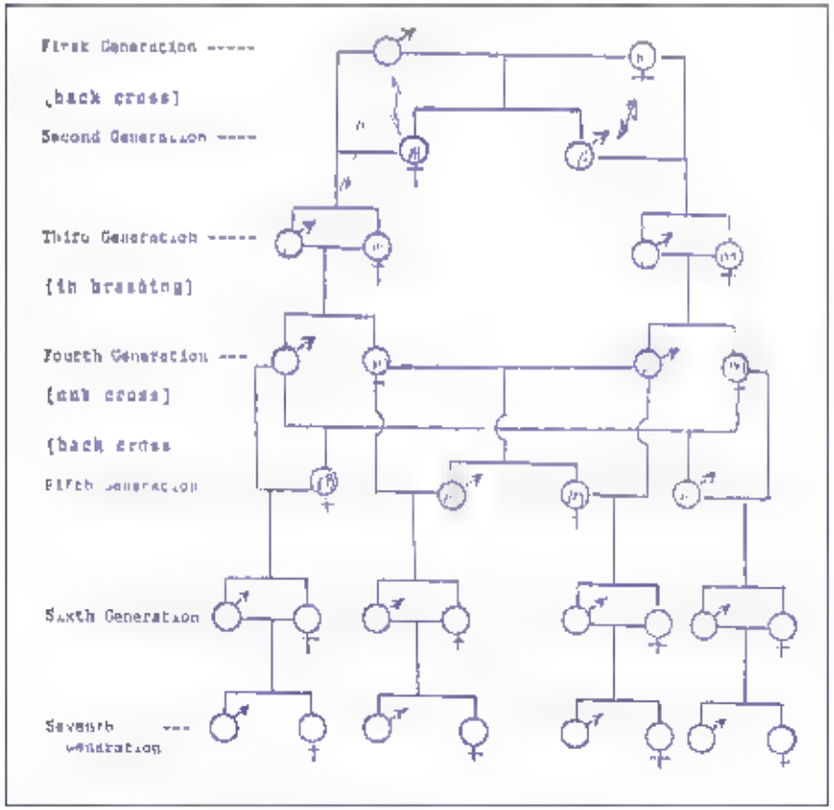
female from the other and the female from the first mated with the male of the other.

Again you conserve your breeders because following your outcross, you re-establish your lines by breeding mother/son and father/daughter on both sides of this cross. This will give you four lines. If you take the better line from each of your new units and continue inbreeding with your new parallel lines, this sequence can be continued indefinitely as in each unit of inbreeding you are building up a series of generations of fish which are only distantly related to each other. Each time you cross lines, it has the effect of bringing in unrelated stock.

If you remember to select and cull, select, and cull, and to maintain your parallel lines for your crosses, you can improve your fish immensely in a few generations.

The diagram shows in simplified form the natural breeding and steps to fix the first two and then four lines by back-crossing at appropriate points (i.e. mother/son, father/daughter), crossing and inbreeding (brother/sister) between times.

LINE BREEDING DIAGRAM



SELECTING BREEDERS

by Elvis Bryant

Before we go into details on breeding, let me straighten the misconception that people in general have about guppies..."Guppies, you just put 5 males and 5 females and let nature take its course" Well, nothing can be farther from the truth. No one can breed good guppies this way: there is too much chance that some will be bad, and, of course, nobody can predict a certain female's offspring in advance.

The most positive way to select breeders is to first determine what you want. Is it size, color, or both? One way may bring color but will lack size; another way may increase body size but lose color. Now you have taken that step, you want size and color together.

Male first...I watch the caudal region, what I want first is a delta caudal. I watch all my males for a good 60 degree spread. Next I want my male to be a good solid in the caudal region. Next BODY size. I select the largest body size with all the requirements I desire in the two steps mentioned above.

You may have males with all the factors. In most cases good guppy breeders will have a dozen males to select from, but try to cull these down to two.

Females are very difficult to select. Carefully watch the females for color in the caudal area.

A **CLEAR** region in the caudal is most desirable for blotches of mixed colors can be a lot of trouble. Next size of caudal. Pick a female with a nice high-swept caudal.

Next the membrane (**PEDUNCLE**) this is the region before the caudal. Pick your female because of a thick membrane in this area. The thick membrane will help the offspring males to hold their large caudals.

SHAPE - Be especially careful for shape. This can be dangerous. If you pick a female with a crooked spine. Sometimes an overhead view is best to determine this. A strong light to view these areas is always helpful. If you waste six months breeding only to find you used a female that had a crooked spine you may be a little mad.

SIZE - If you have cleared the three areas covered, you now can look for the largest female with all the characteristics mentioned before.

TRIOS...one male, two females....are the best. I believe control is the best answer for raising a trio. When the females are beginning to fill up with roe, separate them. You are better able to determine the quality of the young. Be sure to label each to tell months later from which female the young came. You may have a regret if all the young are mixed.

A young female may not have many young at first, but as she matures the amount of young will increase. By young I mean 4 to 6 months old. An older female does not mean better young. In fact, it is found to be opposite. Then after three groups of young, you will find it best not to take any more young from this female as she would be past her prime age.

EXCERPTS ON BREEDING

The Importance of Selecting good Breeders

by Bob Harris (The Kribun, 971)

Choosing the best guppies for breeding has always been a problem. When most people are preparing to choose their fish, they tend to look at the males and more or less forget about the females. Many people who cannot choose proper females, even though they have the proper males, will eventually lose. When you come right down to it, the females are more important in the breeding process than the male as in some strains the female guppy may have as much as 60% of the characteristics which the offspring will inherit the male 40%. Therefore it is a real guppy breeder who can choose the females. The males are simple by comparison.

Since it is a most impossible to get all of the desired characteristics in one fish, you must break it down. Most breeders use different lines of fish for different characteristics. One for the tail shape, one for tail color, one for body size, one for dorsal color, etc. After awhile you can combine a few of these characteristics in one strain. All this is for just one color strain of fish.

Selecting Breeders

by Warren E. Young (Lyre Tails June 1971)

The female has a lot to do about the size and finnage of the next generation and also a good deal about color. The majority of good guppy breeders do their breeding by trios, a combination of one male and two females. The idea is to find out what combination is producing the fish that he is after. I usually mark my females by cutting the top of one tail and the bottom of the other. The fry will be kept in separate tanks. In two or three months we can tell if we have a good pair. If not keep trying females until we get what we want, and it won't be long before you are producing good fish.

The question always arises that why don't all your females throw good fish in following generations. The better your line is set, the better your chances, but for some unknown reason, fish will go backwards toward their original state much faster than they will go forward. So it is always a battle to find the right females.

Disadvantages of Inbreeding

Dr. F. Schmidt (TFH Jan. 1965)

Besides having many advantages, inbreeding also has considerable disadvantages which almost always lead to failure. When we aim for certain characteristics by inbreeding, a number of traits become irretrievably lost. Loss of virility would head the list. In contrast to linebreeding, the stock can be said to be pauperized.

Another example serves to show that it can sometimes be impossible to combine two favorable qualities. We find the most highly differentiated color patterns with guppies of small size. The best known in Europe are the unusually lovely emerald green Vienna guppies. If we attempt to carry over this finely etched pattern to the larger-bodied guppies, it becomes pulled apart and the innate character of its delicacy is lost.

DEVELOPING NEW CHARACTERISTICS THROUGH MUTATIONS.

If you want to come up with something new in the way of guppies, keep a sharp eye out for the unusual in your rearing tanks. Chance mutations spotted by serious breeders are probably responsible for the fine finnage we have on guppies today. Combined with careful breeding programs many of these mutations have become established and true breeding.

SEEK AND YE SHALL FIND

by Brian Newman

Mutations are not rare, they occur frequently, but most pass unnoticed. Consider some of today's fish which are the result of mutations, the lordly betta, the multi-colored platies and swordtails, the popular and beautiful veiltail guppy. In recent years hobbyists have become more aware and more observant, thus the increase in new variatys.

Of course, not all odd fish we see are true mutations. Many such fish are deformed as a result of damage sustained by embryos... congenital defects. How can the average hobbyist distinguish a congenital defect from a true mutation?

First of all let us look at some of the basic forms a mutation can take: longer or differently shaped finnage, excess black pigment, lack of pigment, etc. Prime examples of finnage variations are the hi-fin swords and veiltail angels, excess black pigment is exhibited by the black molly, lack of pigment by the albino fish, although fish such as the gold guppy also show a partial lack of pigmentation. Generally speaking, color variations are not congenital.

Assuming that a suspected mutant has been discovered, the work of the hobbyist has just begun, as there is only one true test of a mutation. This test involves the development of a true-breeding strain, all young of which will exhibit the new characteristic. Before the work is commenced, the breeder must ask himself if the suspected mutation is worth the time and effort involved to get it to the market place. Remember, not all mutations are street ve...some can be downright ugly. However, when the decision is made one factor which should influence the thinking of the hobbyist is, what would the fish look like if the variation was intensified? For example, a dusky variation may, by selective breeding be developed into solid black. Similarly, a rust or pink mutation could become orange or red.

Having made his decision, the next step is to see if the suspected mutation is bonafide. If there are a number of affected individuals, and two are of the opposite sexes, the best plan is to mate these two together. The next method is to mate the fish back to its parent, if possible. If this is not possible, the mating should then be made to a brother or sister. The idea here is to attempt to concentrate the genes responsible for causing the original variation from the norm. If the mutation is dominant, a percentage of the young should exhibit the desired characteristics. If however, you find no fry resembling the parent being tested, do not give up hope. The mutation may be recessive. Thus, in order to produce a further concentration of the desired genes, one or more of the first generation offspring should be bred back to the affected parent, or, if this is not feasible, the young should be interbred, brother to sister.

If as the second generation young develop, the desired characteristics are not evident, it can safely be assumed that the variation was indeed, a congenital defect, not a true mutation and we must return to our rearing tanks and begin our search anew.

So, seek and ye shall find. This means everyone. Mutations are not the result of experience, the beginning aquarist is just as likely to have one in his first spawning as is the old pro in his thousandth. Happy hunting.

(Condensed from "The Valley Stream" Dec. 1971)

WHAT IS A MUTATION

by Midge Hill

What causes mutation in the first place? What is a mutation?

Heredity is basically self-reproduction, and the units of self-reproduction are the genes. Usually genes create exact copies of themselves, but once in a while something goes wrong with the copying process, and a gene is formed that varies in some way from the original. This change can affect a vital function, it can be as accidental as a minor color change, it can be as dramatic as adding a double dorsal fin, etc.

Mutations arise from time to time in all organisms and have been fairly frequent in the prolific guppy. Although mutations have changed the short tails of the wild guppy into today's wide delta fins, mutations are by no means limited to fin shape. They can affect color of body and fins, size or shape of body or fins, fertility, growth rate, behavior, internal structures, bodily functions, etc. With some mutations visual differences are almost non-existent, others are quite obvious. Still others, the vast majority, produce changes so drastic that the organism dies in the embryonic stage or shortly after birth. Most mutations are harmful to the individual in the environment in which they occur.

Experiments have shown that the percentage of mutations can be increased by certain environmental factors: X-Ray, ultraviolet rays, high temperatures, the use of certain chemicals, etc. An even easier way that has worked more than once for me, is to keep a female virgin until almost two years old. One such two year old female when bred (breeding doesn't always take at this ripe age) produced just one litter before dying of the shock of it all. However, in that one litter was one albino (Apparently a true mutant as the albinism occurs on a different gene from any other albino I have ever found in the 15 years I have worked with this species) and two pairs of siamese twins. Another virgin bred for the 1st time at about 18 months threw two fry with double dorsal fins. (Unfortunately, careful breeding of a number of generations of fry from one of these unusual fish never produced another double dorsal...leading to the belief that the 'error' occured in the process of cell division rather than altering the hereditary pattern.)

Even though the majority of mutations are of little use to either the breeder or the guppy itself, an observant breeder can sometimes spot a mutation which makes possible a new characteristic for our guppys. And much progress can be made if it is remembered that mutations need not be only used to enhance the outward appearance of the guppy. Mutations can be used to breed more disease-resistant fish, fish with more active mating displays, fish with more or less aggressive personalities...the list is endless.

INDUCING MUTATIONS

by Harry Matson

It is not every day that one gets a call from a friend who asks if one wants the use of an X-ray machine for experimental purposes. It was just such a call which I received almost two years ago from Stan Mruk of Chicago after he had conducted an experiment with an X-ray treatment of some guppies. He informed me of his results and suggested an experiment of my own, offering me the use of the X-ray machine.

One week before I gave some of my own guppies an X-ray treatment, Stan had given some of his fish 5000 roetgen for five minutes. Stan did not notice any ill effects on the fish, but as a matter of fact said that he had never seen any fish so active.

I was glad to accept the use of the X-ray machine, inasmuch as several of our local club discussions were spent speculating as to how we could possibly upset the genetics of our fish. Furthermore, I had noticed that everytime I got a decent yellow strain going, a lot of black pigmentation cropped up from time to time. I had also noticed that a good many times when blacks were exhibited, or somewhat excited or frightened, they would show up as a darkened yellow or an olive green, unless the breeder used anise or some other coloring agent. I therefore felt that this was an opportunity to see if, with the X-ray, I could make yellow guppies produce black.

I exposed some pregnant females to 10,000 roetgen for five minutes. Pregnant females were used so that I might at least have some young stock to work with had the subjects died shortly after the treatment. Contrary to My expectations, the treatment had no sterilizing effect. Two weeks after the treatment, the first fry were born, and fry continued to be born every twenty-one days thereafter.

At the age of one month it was apparent that there were a lot of black young, and these developed perfectly until the age of three months. At this stage of development, every black-tailed male died. This pattern continued for six generations, one third of each brood being black. The yellow fish always did well, on the other hand, for the care that they received.

FUNCTICUAL SEX REVERSAL.OF THE POECILIIDS

by Tony Berruges

I will, in this article, cover the process of fertilization in livebearers and the work which has been done on sex reversal. I will terminate this article with recent conclusions on this subject.

FERTILIZATION, SPERM STORAGE IN FEMAIES'AND VIVIPARITY

In the Poeciliids the ovum is fertilized while still in the follicle. The follicular cells (which separate mature ova from the central ovarian cavity) turn out to form a cells (funnel-shaped invagination) shortly before the arrival of the sperm. At the apex of the de le, a minute pore permits the entrance of the sperm. The embryos which result from this fertilization develop in the follicle. When the time for birth arrives, the follicle ruptures, releasing the young for birth.

Females are able to store sperm in the oviduct for long periods. Fertilization of eggs months after contact with males is possible. The ovary contributes to the food supply of the embryos by the secretion of nutritive fluids into the follicular or ovarian cavity. The embryo is bathed in and swallows or absorbs this fluid through the skin.

SPONTANEOUS ADULT HERMAPHRODITISM AND SEX REVERSAL

Hermaphroditism in Poecilia is not regular. In 1957 H. Spurway recorded functional bisexuality in a guppy and in 18 of its young. Parthenogenesis was discarded in view of the co-existence of functional testicular and ovarian tissue and the likelihood of self-fertilization. The offspring of the 18 fish were all females.

In a second type of hermaphroditism, adult fish are morphologically of one sex, but subsequently undergo spontaneous reversal to the other sex. This condition is known as protogynous if the ovary develops first. If the testes develop first, the condition is known as protandrous. Most instances of sex reversal are reported to be protogynous rather than protandrous.

Although exceptional, protogynous sex reversal has been described repeatedly and in full detail. Before the sex reversal is started, a female must first give birth to young in order to prove that she is a functional female instead of an under-developed male. After the sex reversal, neomales (Newly formed males) must demonstrate the completeness of the transformation by successfully impregnating virgin females.

In the process of sex reversa , the oviduct is converted to a sperm duct. The ma e coloration replaces that of the female. The gonopodium beg ns to develop. Oviposition is arrested and the female's characteristic gravid spot between the pe vic and ana. fins fades. As the gonopod um begins to grow, the ova disappear and the fol icles become atretic. Most of the ovary disintegrates, leaving the epithelium of the ovarian cavity. Leucocytes (white blood cells eventually dispose of the masses of ovarian debris. From the resid- ua epithelium, radial sex cords rapidly pro iferate to form a testes. The germ cells then mu tiply quickly.

Eventua ly, the new testes is ndistinguishable in morphology, location and fi nction from the testis of a typical ma e. The sex chromosomes of the neomales are XX, however, as opposed to the XY of a typica male. All the offspring of a neomale and a typica female are females. The process of sex reversal may require from three to four mon hs.

EXPERIMENTAL SEX REVERSAL

In X phophorus another type of livebearer), feeding by adding it to aq arium water...of testis powder or testosterone propionate to pregnant feme es and to the young when they were born, had the resu t that all the young which grew to maturity were males. Intramuscular injections of testosterone propionate into pregnan females, immature fish and adul, non-pregnant females caused complete mascu inization of some, but not all fish. Male sex characteristics were conspicuously developed in all cases in carefully controlled experiments carried out in a similar series. A fish obtained masculinization, in about one half of the cases with spermatogenesis.

Various estrogens, when given to immature male Xiphophorus, caused the appearance of a testis-ova. Accessory sex structures may be influenced by administration of heterosexual sex hormones, particularly androgens, at any time. The sex of the gonads of embryonic, immature and sometimes mature fish may be partially or completely reversed by the same agents. Further study is needed in the histologic details of each stage of reversal, as well as in the measurement of androgenous sex hormone levels in blood and in the gonads.

DISCUSSION

Although sex reversal has been reported in previous years, the concept of sex reversal in the livebearers is currently being disputed. Internal morphology does, in fact, change considerably. However, before a live-bearer can become functional y sex reversed, it has to have a functional gonopodium. This is where the concept of functional sex-reversal in the livebearers is questioned. In order to have a functional gonopodium, that is one which is able to pivot, the fish needs a modification of the hemal spines called gonapophyses. These bones are necessary for the proper functioning of the gonopodium during copulation. Females which undergo sex reversal, treatment generally do not develop the gonapophyses even though their anal rays do modify into gonopodials and the anal fin rays do develop into a gonopodium, however, not quite like that of a normal functional male.

The correct procedure for conducting a sex reversal experiment requires several hundred impregnated female livebearers in order to increase the odds. Even in reported cases, the percentage of sex reversed females is very small. Conditions then have to be standardized in order to exclude the environmental interference. The females have to give birth to healthy young. They are then subjected to a standardized treatment, all females receiving an equal amount of testosterone. The female young from the birth should be isolated in order to maintain them as virgins for experimentation further on. At the end of the treatment the neomale is placed in a tank with one of the virgin females in order to ascertain whether or not sex reversal is complete. If the female gives birth it must have been from the neomale since she was isolated from any other males previously.

An "experiment" conducted in the Fisheries Research Laboratory at Southern Illinois University attempted to prove or disprove the validity of sex reversal. However, several discrepancies were noted. First only one fish was used. Even in the most successful of the sex reversal experiments cited, only a very small percentage of the females were successfully reversed. Secondly radiographs (X-rays) were used in order to observe the developing bone structures of the gonopodial suspensorium. This is not valid if results are to be published since the radiation from the X-ray machine would very possibly (and probably did) alter the newly forming cells sufficiently even if everything else were proceeding properly. Thirdly, the female died before any crosses with virgin females could be set up. If anyone wants to read the write-up of this "experiment", it was published in the August, 1971 edition of "Tropical Fish Hobbyist". Note, I would not dispute their findings if these discrepancies were not noted. However, in order to prove or disprove the concept of sex reversal, properly documented experiments should be run.

Bringing It All Together

WHAT YOU SEE IS WHAT YOU GET??

by Ginny Lan

Not necessarily when looking at guppies. Did your beautiful new guys not breed true? and you got a conglomeration of babies that look like their father was a traveling man?

First, some of the biggest show winners have bagged their trophy with fish that do not breed true. They have found that a first cross yields a fine big hybrid. As long as they maintain the two strains separately, and then crossing the strains, they are able to get that same gorgeous hybrid.

But he who bought himself a pair of hybrids will have to be ready to handle them accordingly. The fry from this pair will always be a duke's mixture. But if you breed the sons back to the mother, father to the daughters, or brother to sister, the story begins to unfold.

I remember one example when we had three males tied up with half-black-red males and their sisters. A friend paid a good price for them expecting to be started on a good strain. After raising several batches of fry he found it a mediocre strain indeed. Most of the males had weak red tails and a broad streak of white down the backbone. He brought them to us, stating his disappointment in the strain.

We started with a trio of fairly nice-looking fish, for he had brought us some of the best he had raised. We brought several batches of the fry to a size that would begin to let us see what was wrong with the strain. When scrutinizing the young males we found pretty much the same situation described above, but the females were a horse of a different color literally. We found THREE distinctly different kinds of females among the sisters, females who were black-bodied with green flashes in the tails, females with grey bodies and the bodies white opaque tail usually found in a red strain, and the females we sought black-bodied females with brilliant blue flashes in the tail. This was the breeder we counted on to give us the nicest red-tailed males.

We placed these females with the best, deepest red-tailed males and the show was on the road. Ordinarily we would not bother breeding the others, but in this case just to prove out the fish, we allowed them to breed. The grey-bodied females continued to throw the same majority of weak-colored males; the green-tailed black females threw a larger percentage of nicer males with still some very, very mediocre ones. The blue-tailed black females came on like gangbusters with vivid red-tailed males and black, black, blue-tailed females in the majority. Of course, we still picked up a few mediocres, but if we continue breeding only the blue-tailed females we will gradually have these fish breeding exactly the way we want.

If you have been working with a nice strain for awhile and suddenly note you are picking up a few odd-looking males, different than they should be; maybe, for instance, your good green strain starts showing

male tails that are decidedly more blue than green... take a closer look at this strain. If you allow the fish to continue to breed as they have been breeding you will be apt to continue to get these odd males. Invariably when the males deviate, so do the females. It may not be easily obvious, but close observation will reveal differences in your females also.

We would not deliberately breed the good green male into one of his odd sisters, but if we were interested enough to pursue it, we would breed that ODD male into his ODD sister and soon would find that we had crossed back into some ancient ancestry of recessive genes, and we could have a pure strain going along this line in time.

So...don't spend all your time selecting a breeding trio strictly by appearance of the male. The female is the key to quick success. If you get the wrong color female, the information in this article will help you to work your way back to where you are supposed to be without scrapping the strain. Females have much more color now in their tails than they did when we started guppying, and color is the key. If she has no color in her tail, look at her gill plates for flashes of color,...or the sheen on her scales as she passes through the light. A good green guppy will flash green. A good blue will flash blue. A red guppy will also flash blue. You will have to go to the tail to differentiate here. A blue strain female will show a clear tail with blue flashes. A red female will show a tail that is opaque, more blue than white but whiter than blue. As she matures she will have red in the tail also if from a really fancy strain.

If you want to breed guppies you must learn something of the sciences, in this case genetics, and mix that knowledge with tricks and techniques gained by actually working with the fish and other people who are doing the same thing.

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Bringing It All Together

HOW TO OUTCROSS GUPPY STRAINS

By Midge Hill

Taken from the August/September 1973 issue of the GUPPY GAZETTE

The following article is based on remarks made to the regular meeting of SCGA on June 7, 1973 by Midge Hill. "We all know that the best advice one can receive (and follow) on how to breed show guppies is, "...get a good quality, well established strain and then keep it as pure as you can." Keeping a strain pure is called inbreeding the strain. Inbreeding means the breeding of fish that are closely related to each other genetically, such as brother to sister, father to daughter, etc. A technique known as outcrossing is used by some breeders to maintain an established strain, and it also comes under the general heading which we refer to loosely as inbreeding.

Outcrossing is the opposite of inbreeding since outcrossing means the mating of fish that are genetically unrelated to each other. Now the reason that all successful guppy breeders outcross strains from time to time but seldom advise others to try it, is because outcrossing is really a form of genetic Russian roulette. A successful outcross requires that the strains which are crossed may be genetically compatible. The odds against finding two compatible strains are very high. Even when a good result is obtained from an outcross it is as often due to blind luck as to intelligent selection.

There are times, however, when outcrossing may produce something that no amount of inbreeding within a strain will accomplish. There are also times when your only alternative is to outcross, for example, when you buy a fish at a show auction without a related mate. Fortunately, there are ways to improve your chances of getting a good result from an outcross. And this is what I want to talk to you about tonight. That is, when to outcross, how to pick the outcross strain, and how to proceed after the initial outcross to get the best result in subsequent generations.

Before I get into the good reasons for outcrossing, I want to point out that there are a lot of no-good reasons for outcrossing. Now there is nothing wrong with outcrossing just for the sake of idle curiosity or for some other frivolous reason, as long as you do not pass these fish along. What outcrossing does is to rearrange, to scramble together, the genetic patterns of the two parents. Therefore, offspring from an outcross are genetically all mixed up. They are referred to as hybrids. Play with these hybrids if you want to, but do not pass them along, for they are genetic accidents and are not going to do much good for the hobby.

Getting back to the good reasons for outcrossing, in my view there are five situations in which outcrossing can be a suitable thing to do.

1) **When an established strain will not produce characteristics you want (a larger dorsal, perhaps) because the gene pattern for that characteristic is simply not present in the strain.**
2) **When you are having trouble with an established strain, infertility, maybe.**
3) **To outcross for big show hybrids.**
4) **Necessity, as in the case of a male purchased at a show auction without a related female.**
5) **To create your own strain.**

I want to discuss each of these five situations in detail, to tell you why I think outcrossing, as chancy as it is, can be a good thing to do, and how to proceed after the initial outcross, because the breeding techniques are a little different for each type of outcross.

In the first situation, where you have a good established strain but you have not gotten a certain feature you want by inbreeding or linecrossing within the strain, outcrossing can be the solution. Let's say that you have been working with a strain of reds which are not as bright a red as you would like. Dr. Clark has told us there are about four or five different genes for red. If your strain does not have all of these genes, no amount of inbreeding is going to produce what is not there to begin with. So, you can outcross to try to pick up the missing genes that are needed for a cleaner, brighter color. Or perhaps, you have been trying to get a larger dorsal. You might be able through inbreeding by careful selection of parents, to get gradually over the years, a larger dorsal, maybe. But there is a chance to use an outcross to pick up a larger dorsal more quickly.

It goes without saying, doesn't it, that you do not want to lose the fine characteristics of your original strain. So, while you are trying an outcross, you must keep your established strain going. Otherwise, if the outcross does not work, you will have lost your strain.

Well, what strain do we pick to outcross into an established strain when we want to add a new feature to the established strain? The outcross strain should also be well established that means the strain has bred true over several generations, so that all of the males in each litter look very much alike and each generation looks very much like previous generations. The outcross strain should be of the same type as the strain you are going outcross it to. In other words, you should outcross red to red, blue to blue, halfblack red to halfblack red, etc. And, obviously, the outcross strain must have the particular characteristic you are looking for.

When you find a strain that meets the above three requirements as much as possible, you make the outcross both ways. Take your best male and mate him to females of the outcross strain, and also take a male from the outcross strain and mate him to females from your original strain. You do this because you

do not know which way will come out best. And, of course, you have to keep the young separate, so you can determine which way the outcross works best.

Offspring from an outcross are referred to as the F1 generation, the second generation after the original outcross is called F2 generation, and so on. If you find a male in the F1 generation that looks like your original strain and also has the new feature from the outcross strain that you were trying for - well, you are just about as lucky as it is possible to be. What has happened is that the feature you wanted proved to be dominant, and so it appeared in the first generation. This happens sometime, and when it does you breed this F1 male to females from your original strain. (Remember, you have kept your original strain going.) This is the proper procedure, because you want to work back into your original strain as soon as possible after an outcross. Breeding the F1 male that looks most like your original strain and which also has the new characteristic you want to females from your original strain produces the F2 generation. You continue to do this, using only females from your original strain, because you must keep working the new characteristic back into that original strain.

We have been talking about an outcross which produces the feature we wanted in the first generation. Many outcrosses will not be so lucky, the feature we want will not appear in the first generation, but that does not mean it isn't there. There are two reasons why a feature possessed by a strain used in an outcross may not show up in the first generation: a) the feature is recessive, or, b) it is carried only by the females.

If a special feature you want (and which was present in one of the strains used in the outcross) does not show up in the F1 generations, you must take brother and sister from an F1 litter and breed them together to find out if the trait is recessive. If it is recessive, it should show up in 25% of the offspring from this sibling breeding. Assuming that the feature is a recessive, and it shows up in the F2 generation (from breeding F1 brother to sister), you pick an F2 male that looks most like your original strain and which has the new feature and then breed him to females from your original pure strain which you have kept pure for exactly this purpose. This gives you the F3 generation from the initial outcross.

This F3 generation will now show the recessive trait. (From here on it is going to Sound complicated, but it really isn't.) You must remember that what we mean when we say a trait is recessive is that an individual will not display a recessive trait unless he (or she) got the necessary genes from both parents. This F3 generation had and F2 male which did have the recessive trait for their father and the mother was from your original strain which does not carry the recessive; therefore, the F3's got the recessive genes from only one parent. Each offspring in the F3 generation carries the recessive genes, but there will not be visible evidence of it. The next step is to breed brother to sister from the F3 to give offspring, 25% of which will again show the recessive trait.

You can see that when you are breeding a recessive trait back into an established strain which does not carry the recessive, you have to use a two generation cycle for a while. In other words, every other generation you will breed sibings and in the alternate generations you will breed back to your pure strain females.

You remember we said there might be another reason why a trait would not show up in the first generation. It might be that the new trait was passed to the F1 females, but not the F1 males. But you never know.

Therefore, besides breeding brother to sister from the F1 generation to see if the missing trait is recessive, you must also breed some of the F1 females to males from your original strain to see if the trait you are working for is not recessive, but just carried by the females. If you get the new trait by breeding F1 females to your original strain males, you are off and running. That is, you would breed the males from your original strain into the hybrid females, which will be getting closer genetically to your original strain after each generation of breeding.

In summary, when an outcross is used to try to add a feature to an established strain, one of three things will happen in the fifth generation: 1) the desired trait is dominant, 2) it will not show in the first generation because it is recessive, or 3) it will not show in the first generation because it is carried by the females. The dominant trait and the trait carried by the females are the easiest to handle. The recessive trait is more difficult. But in all three your whole purpose is to breed the new trait into your original strain as often as possible.

This breeding back to your original strain will mean that you are purifying the hybrids, but it also means that the hybrids will be getting more and more like your original strain. You may start losing the feature you made the initial outcross for and which you got in the first generations after the initial outcross. You have to watch out for that. If things start going the wrong way, then you begin mating brother to sister within the hybrids to see what happens.

Now let us go on to the second situation in which I believe an outcross can be a good thing to do. This is the case of an established highly inbred strain which has developed a major genetic flaw such as infertility, a high percentage of crooked spines, susceptibility to disease, etc. An established strain which is rapidly going downhill because of a genetic problem (but which is still beautiful in other ways) can sometimes be rescued by careful selection of breeders without resorting to an outcross. You would want to try to do that first.

Let me say here that inbreeding guppies, even very close inbreeding, is not of itself harmful. Guppies will take close inbreeding for many generations longer than most of us continue to work with any one strain. Without significant loss of size or color or vigor. Dr. Eugene Lart and Dr. W. K. Heideman, to mention only two genetic scientists who have exhaustively tested the effect of inbreeding on guppies, have both bred guppy strains brother to sister for over eighteen consecutive generations without loss of their desirable characteristics. When highly inbred strains develop serious genetic defects, and they often do, it is not because they have been inbred for a long time. It is because the guppy breeder picked fish to use as parents that had some invisible weaknesses. Though these weaknesses do not show in the parents, they will show up in succeeding generations, usually in the form of deformities and/or lack of fertility.

This sort of thing happens to the best of us. And it is a serious problem. After all, if the point is reached that a strain produces no young, the strain is lost. Or a well established strain will begin to throw a high percentage of deformed young in each litter but the fish which survive undeformed are still beautiful. You would want to try to save these strains.

But what if your established strain just gets worse, no matter how careful you tried to pick the best parents you can try an outcross. You still must keep the original strain going if you can, because you are going to bring back the outcross hybrids into the original strain as fast as you can.

Again, when you pick the outcross strain, you will want one which looks as much as possible like your own strain, one which is also well established, and one which produces fertile and vigorous young.

This is a big order I know, but having acquired a strain to outcross to your own strain for the purpose of improving fertility and/or vigor, you will proceed as follows. Outcross both ways if at all possible. That is, take your best male and mate him to females of the outcross strain and also take a male from the outcross strain and mate him to females from your original strain. Again, you must keep the offspring from these matings separate. When these F1 hybrids are old enough to select breeders, you pick a male from the best looking of the F1 litters and breed him into females from your original (pure) strain. And you keep doing this in succeeding generations, working the hybrid males back to your pure strain females.

If you have enough tank space, you can also try working back into your original strain in the other direction. By this I mean you can also try mating the hybrid females from each generation after the outcross

back to your pure strain males. My own experience is that you will get better results with the first method, that is, by breeding the hybrid males through your pure strain females. But if you have enough tank space it wouldn't hurt to try it both ways.

Perhaps I have not said enough about why you want the outcross strain to be a well established, true breeding strain. Remember, that what an outcross does is scramble together the genetic patterns of the two strains which are crossed. If one side of the cross is itself only a few generations away from a previous outcross, all you have accomplished is to further mix up the genetic patterns. Long experience and experimentation have proved that these hybrid-hybrids may look good for a few generations, but that their mixed up gene patterns soon cause them to regress back to a small, motley fish like their wild ancestors.

To be continued

Bringing It All Together

This is the second half of a two-part article based on remarks made to the regular meeting of Southern California Guppy Association on June 7, 1973 by Midge Hall on the subject —

HOW TO OUTCROSS GUPPY STRAINS (PART II)

Just to refresh your memory, I would like to briefly summarize what was said about outcrossing in the first part of this article which appeared in the May issue of the Roundtable.

First, the best way to breed show guppies is to acquire an established strain of good quality and then keep it pure by inbreeding within the strain. An established strain is defined as one that has bred true over several generations, so that all of the males (or females) in any given litter look pretty much alike and each generation looks very much like previous generations. Inbreeding is the mating of fish which are closely related to each other. The closest relationship is brother-sister, the next closest is father-daughter or mother-son. When a guppy breeder says he is inbreeding a strain, he usually means he is using sibling combinations. But any mating of fish which are related to each other falls into what is loosely referred to as inbreeding.

Second, even though inbreeding an established strain is the best way to get good fish, experienced guppy breeders are usually experimenting with outcrosses most of the time. Outcrossing is defined as the mating of fish which are unrelated to each other and is therefore the opposite of inbreeding. Offspring from an out-cross are called hybrids.

There is no way of knowing what result you will get when you mate two unrelated fish. If you just crossed unrelated fish in a random manner, you would get a good result on the average of only once in every 500 outcrosses. (This is why experienced breeders do not recommend it.) Fortunately, there are ways to increase the odds of getting a good result from an outcross. The two rules you must follow are:

1. **Both sides of the cross should be from well established strains. At the very least, one of the strains used in the outcross should be a true- breeding strain.**
2. **In most cases, both sides of the cross should be similar to each other — that is, cross red to red, green to green, black to black, etc.**

And third, I said there are five situations in which I believe outcrossing is a perfectly respectable thing to do. They are:

1. **When an established strain will not produce a characteristic you want because the gene pattern for that characteristic is not present in the strain.**
2. **When you are having trouble with established strain — infertility, perhaps.**
3. **To outcross for big show hybrids.**
4. **Necessity.**
5. **To create your own strain.**

The breeding techniques are a little different for each of the five situations. The breeding programs to follow in the first two instances were covered in the first half of this article. So now, let us get on with outcrossing for big show hybrids.

If you are very lucky and are willing to devote tank space to an endeavor with very long odds, you can keep trying to find two established strains that, when crossed, will produce an outstanding result in the first generation. You just might stumble onto one of those compatible combinations that will throw big, beautiful show specimens. You must have well established strains on both sides of the cross to get this kind of a result.

One unique thing about this type of outcross is that there is no breeding program after the outcross. What you are trying to do is to find two strains that immediately produce beautiful show fish. Then you keep and inbreed both of these strains separately, outcrossing the two strains to each other to get show specimens. You will not breed from the outcross. The hybrid females from the outcross are discarded early (no point in wasting food on them), and the hybrid males are raised for show but never bred either.

There are a number of people, myself included, who have gotten their winning show fish this way. Chris McKay of Canada, for instance. Anyone who saw the bucks he won with at every show for years, will remember them. These show winners were not from a strain of blues. They were hybrids which came from crossing two different strains which he kept separately and which he outcrossed when he wanted show blues.

Another unique thing about this type of outcross is that some people who have found one of these magic crosses started out with the oldest dungs. They crossed some scrubby looking half-wild strain to another very inferior appearing strain, and got beautiful fish.

I want to confess that I spent years trying outcross after outcross, but I did not find that elusive combination that would produce big show hybrids for a long, long time. But I finally found that I use one strain of small veiltails that carry brilliant color and cross it to a strain of big-bodied, big-finned, bluish-colored fish. Outcrossing these two strains gives me large, beautiful hybrids. But breeding these hybrids brother to sister produces nothing that is worth a hoot.

If you ever find this sort of a combination, don't spread the hybrids all around the world for other people to get loused up with. It's a pretty dirty trick to put one of these hybrid males in a show for auction, even sending one of his sisters with him. Sure, you can say the pair is related (brother and sister, yet), but you also know that the purchaser of these fish can't get anything worthwhile from such a pair. If you send hybrid males overseas, always label these fish as being hybrids, so that the overseas club will not unknowingly use these fish under false pretenses.

Question from the floor: Why couldn't you breed these show hybrids back to one of the pure strains that produced them?

Well, I don't know what that could accomplish. Which side of the cross would you breed back to — the one with the teenie-weenie body and small tail or the one with the big body and poor color? You

would end up, I think, getting back to small size or blah color. I have not tried it, frankly, so I do not know for sure. I have proved to myself that inbreeding the hybrids from this outcross produces nothing of value.

The type of outcross we have been talking about is sometimes described as having hybrid vigor, but that is a misuse of that term. "Hybrid vigor" (which scientists call heterosis) is properly used only in referring to the special qualities produced by outcrossing two strains so completely different that nothing matches genetically. This type of outcross will always result in completely sterile young.

One of the best known examples of true hybrid vigor is the mule --- which is large, strong, and always sterile. The true heterosis cross can occur in guppies. When it happens, very infrequently to be sure, you can recognize it because all of the males will be big, beautiful, and will all look almost exactly alike, besides being sterile. For producing big show hybrids, the true heterosis cross is just fine also --- since you aren't going to breed it anyway.

I think that such combinations will be harder and harder to come by. Because so many of the guppy strains we have now have traveled all around the world and have all been all mixed up with one another, I think that many strains cannot help but be getting closer together whether they come from Europe, California, Singapore or wherever. I think that more of the guppy blood is becoming more interelated and though I am not a genetic expert, I can't see how heterosis combinations will occur as often as before --- which was not very often in the first place.

Comment from the floor: In 1968, we got the first German fish shipped to a show here in California from Richard Busch. And today, characteristics of these first Busch fish are still evident in fish being bred here. A lot of fish we are now getting from Germany are very breedable to the fish we already have, because there is German blood in so many of our strains.

Yes, just like the yellows that Gerhard Gellrich sent over here to a show in 1969, I think it was. You can still take Gellrich yellows sent to current shows and breed them to yellow strains derived from fish that Gellrich had sent over three or four years before and get a perfectly beautiful match. The half-black pastels we have now in the U.S. were most all originally from German fish.

Getting back to what we were talking about, I will just summarize by saying that I see nothing wrong with making experimental outcrosses looking for that lucky combination which will produce big, beautiful show fish --- as long as you do not pass these hybrids along to some unsuspecting hobbyist who thinks he is getting good breeding stock.

Outcrossing by necessity is the next situation. Purchasing males without related females at a show auction is the most common instance in which outcrossing becomes a matter of necessity.

Having purchased a fish at auction, in order to decide what kind of female you should mate him with, you first have to decide where you want to go. You should decide what you like about him, why you bought him in the first place. Was it his dorsal, his color, or what? Once you decide this, you should look for a strain to outcross him to that is already well established and which you think will best preserve the feature you bought him for. Almost without exception, the outcross strain should be similar in color, at least basically the same caudal color, as the auction fish.

For instance, let's say you bought a green snakeskin male at a show auction. The outcross strain should be a green strain, but it does not have to be a snakeskin. The reason is that the snakeskin pattern will almost always be carried by your auction male (there are very few snakeskin strains where the snakeskin pattern is carried by the female), and the snakeskin pattern will usually appear on all of the male young when their father was a snakeskin.

If the male you purchased is a gray bodied type, you would probably choose a gray bodied strain with his same basic caudal color to outcross him to. When you get into choosing an outcross strain to go with an albino, a gold, or a bronze, etc. you are getting into a complicated genetic problem. My advice to a beginner, would be to ask one of the experienced breeders in your club to help you decide what kind of strain you should look for.

After you have secured your outcross strain and outcrossed it with your auction male, the breeding program to follow will be very similar to the plan you would follow when you want to add a particular feature to an already established strain. (See Part I of this article). That is, you would breed the F1 hybrid males from the outcross back to females from the established strain used in the outcross. Remember, this means you have to keep the already established strain going on the side. Then you continue mating the hybrid males from each generation to females from the established strain that you have been keeping pure. Just forget about using the females from the hybrid cross. This is the quickest way to set a new strain. While it is true that you are purifying the hybrids this way, it is also true that you are diluting some features of the hybrids, meaning that the hybrids will be getting more and more like the established strain you are working them through. You have to watch for this. If you begin to lose what you liked about the hybrids, start breeding the hybrids brother to sister.

Question from the floor: Why not breed F1 hybrid daughters back to their father and set the strain that way?

The reason I do not recommend breeding back to the original auction male is that nine times out of ten you will know nothing about the fish you buy at a show auction. You do not know if he was from an established strain, if he was the result of a random outcross, if he was from somebody's cull tank that just happened to blossom into a good fish, or just what he was. The chances are pretty good that he is himself a hybrid, or not many generations away from an outcross, and then you outcross him again which makes his offspring hybrid-hybrids. Breeding him to his hybrid-hybrid daughters will just mix up the gene patterns even more. The result will almost always be worse instead of better. If you have the tank space, go ahead and try breeding his daughters back to him. You might get some show males, but to set a strain it probably won't work.

If that male you purchased at auction was from an established strain, that is a completely different thing. In this case, both sides of your outcross were established strains. This is when you may successfully set a new strain by breeding him to his daughters and to his grand-daughters, if he lives long enough. After he dies, you would then continue by breeding brother-sister within each generation of the new hybrid strain.

However, breeding hybrids brother to sister in my experience is a less successful way to set a strain after an outcross. Maybe it will work, maybe it won't. But for heaven's sake, keep your established strain going, because if you lose it you can't ever go back to it. Then you would have to go brother-sister within the hybrid cross and just hope for the best.

The fifth situation in which you must know how to set a strain after an outcross is if you have the desire to create your own special strain. The idea of continuing, even very successfully, somebody else's strain just does not appeal to some people. If you are one of them, you can create your own strain. Obviously, any strain that is developed from an outcross is a brand new strain, and if you did it, it is your strain. So you could start with a fish bought at auction and outcross it to something else. Or you could deliberately set out to acquire two established strains in order to outcross them hoping to preserve the best qualities of each. Or a color mutation of some sort may appear in your own tanks and you would want to try to build a whole new strain of this mutated type. No matter how you start out, the idea is to purify the new strain as quickly as possible,and all of the principles I have talked about already apply equally here.

If you started with an outcross, breed the hybrid males to females from the established strain used in the outcross. If you were lucky enough to have well established strains for both sides of the outcross, mate the hybrid males to females from both of the strains used in the outcross to see which gives the better result. If you started with a mutation that appeared in an established strain, just work the mutation through the pure strain females to set the mutated feature. A lot of new colors, like the half-black pastels, I am sure were the result of outcrosses that somebody made and then purified. Making the outcross is the easy part.

I think the half-black pastels have had more outcrossing done to them since they first arrived from Germany than any other type at the moment. Outcrossing of the half-black pastels was usually necessary because the Germans do not send females. Almost all the fish that come from Germany to our shows must be put into our own females. This outcrossing is producing some beautiful fish, but a lot of half-black pastel strains are deteriorating, also. You can't help but notice that many people who used to win with their pastels aren't anymore. Either they have stopped showing entirely, or these outcrossed strains have not continued to produce good fish after a certain number of generations. You cannot keep on outcrossing every few generations without finally scrambling up the gene patterns to the extent that the fish just deteriorate into a nondescript nothing.

In summary, I want to say two things. First, outcrossing is not the name of the game --- at least not for very long. The real challenge of this hobby is to be able to set and then maintain a true breeding strain which will produce beautiful fish generation after generation, show after show. And second, if you outcross, for whatever reason, good or bad, don't palm off these mixed up fish as being breeding stock. If you send them to a show in the U.S., don't put them up for auction. If you ship them to a show overseas, be sure the shipping bag or your entry form plainly labels these fish as being hybrids.

I wish you all the very best of luck with your next outcross.

(The above article appeared in the October, 1973 issue of the GUPPY GAZETTE)

Bringing It All Together

THE BREEDING OF ALBINO GUPPIES

by Joe Bertagni

Inquiries have long been made in the area of progressive breeding of Albino guppies and much has been accomplished through the efforts of many breeders of merit, who have devoted many years to this infinite study.

Of all the strains of guppies which now exist, the albino is by far the most challenging and difficult to breed; however, they are not as difficult to breed as one may believe.

One must realize that the albino is a freak of nature because it lacks all black pigment in its eyes and has difficulty seeing in bright light.

These and other problems present a challenge to any serious minded breeder who is looking for a beautiful and interesting fish to breed. If the methods used by myself, and other breeders of merit are followed, there is no reason why most of the difficulties encountered in breeding albinos cannot be overcome.

Before we pursue the actual methods of hybridizing, it should be noted that it would be to the readers advantage if he were to study the laws of genetics concerning the inheritance of colors in guppies. It would

also be advantageous to keep a log of all breeding experiments which should include the date of birth and parentage of the fish in addition to keeping a picture log.

Keeping a strain frequently involves the mating of uncle and niece and occasionally aunts and nephews. Because these mates are closely related, their young inherit a great extent, both the good and bad characteristics which the parents have in common.

Most breeding methods involve mild in-breeding, which is also known as "Family Breeding". When using this method, the breeder attempts to arrive at and maintain a favorable percentage in regard to the color and body, and tail size of the fish. At the same time the breeder can select the best fish and improve the line seeking out and eliminating the unfavorable characteristics of the parents.

When selecting a female to be mated, it is important that she be selected on the basis of the size of her body and tail (which should be large), the color of her eyes (deep red is favorable), and her apparent fertility.

Females are not always fertile. They may swell, resorb their young, drop eggs or become egg-bound and die. Unfortunately some of the most beautiful males and females are sterile, but this is the working of nature and nothing can be done. Because fertility is not guaranteed our only course is to use at least six females when mating. This gives us some insurance against possible sterility in some of them.

It is just as important to make the proper selection of a male to be mated. Mating a gold male of Veiltail or Delta tail, large body, good color and tail size with an albino female for the first cross, has one distinct advantage over using a gray male. Although in both the young will be grey, there is a marked difference in the grandchildren. In the grey and albino cross, the grandchildren are 25% albino, 50% grey-albino hybrids and 25% grey. Unfortunately it is impossible to distinguish the albino-grey undesireable for future controlled breeding.

When gold males are crossed with albino females, the grandchildren are 25% gold, 25% albino, 50% albino-gold hybrid (grey in appearance). Since the albino-gold hybrids are genetically identical to their parents for the inheritance of body and color, they can be distinguished from albinos and golds and can be in-bred again and give the same results as from their parents. This three-in-one combination permits the breeder to develop three different types of "fancy" guppies by line breeding the hybrids.

Gold-gg---------- Albino-aa, selected best gold mated with albino female

FIRST GENERATION

ga ---------- ga 100% gold albino hybrid (grey in color)

SECOND GENERATION

gg (25% gold)--ga (50% albino gold hybrid/grey in color)ga--aa (25 % albino)

gg (25% gold)--ga (505 albino gold hybrid) gga aa

One of the best plans for controlling hybrids involves the use of six tanks in each of which a virgin females will be placed. After placing the females in their own tanks, the breeder selects one of his best males for each tank and the male is rotated from one tank to the other. By using this method, the breeder can keep this strain going for years.

The breeder uses traps in order to seek out all albino young, for they are yellow in color and may be mistaken for food and be eaten by their parents. It is necessary to trap the first generation females because second generation females are needed.

Albino young are weak and stay on the bottom of the tank for a few days. In order to prevent a great deal of damage due to water pressure, it is best to place the young in about four inches of water and slowly increase the water level as they grow stronger.

A rigid selection of males and females to be used in breeding is very important for desireable results of the reproduction of fish and achieving a definite goa, which involves arriving at a desired color, body and tail size in the offspring.

By the use of good breeding principles and methods, all the desireable qualities of the strain can be retained and gratifing progress will be made

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